WAVETEK

INSTRUCTION MANUAL

Model 816
Multi-Channel Filter

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Information in this manual is applicable to System 816 mainframes with serial numbers 1233401 and higher, and to System 816 filter cards with serial numbers 1233301 and higher. For mainframes with serial numbers lower than 1233401, the specifications apply only when used with 10 Hz to 150 kHz filter cards.

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Wavetek
Instruments Division
9045 Balboa Ave.
San Diego, CA 92123
Tel: (619) 279-2200
800-223-9885
Fax: (619) 565-7942

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SAFETY FIRST

Protect yourself. Follow these precautions:

- Don't touch the outputs of the instrument or any exposed test wiring carrying the output signals. This instrument can generate hazardous voltages and currents.
- Don't bypass the power cord's ground lead with two-wire extension cords or plug adaptors.
- Don't disconnect the green and yellow safety-earth-ground wire that connects the ground lug of the power receptacle to the chassis ground terminal (marked with ⏚ or ⚠).
- Don't hold your eyes extremely close to an rf output for a long time. The normally nonhazardous low-power rf energy generated by the instrument could possibly cause eye injury.
- Don't plug in the power cord until directed to by the installation instructions.
- Don't repair the instrument unless you are a qualified electronics technician and know how to work with hazardous voltages.
- Pay attention to the **WARNING** statements. They point out situations that can cause injury or death.
- Pay attention to the CAUTION statements. They point out situations that can cause equipment damage.

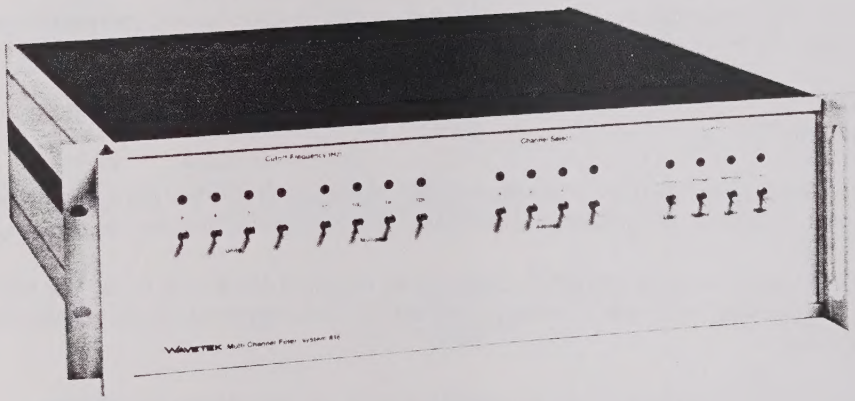


Figure 1-1. System 816 Multi-Channel Filter.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

System 816 is a versatile, fully-programmable, multi-channel filter system capable of processing up to 16 independent analog signal channels. Two 48 db/octave responses are available: an 8-pole Butterworth and an 8-pole Bessel. The Butterworth low-pass configuration may be altered to high-pass, and thus, by combining two channels, bandpass and band-reject filters may also be realized.

Among its many applications, System 816 is widely used in spectrum analysis for band-limiting analog signals prior to sampling and analog-to-digital conversion to prevent the "aliasing" of out-of-band components into the frequency band of interest. In this application, as the sampling frequency is changed, the cutoff frequency of the filter is automatically programmed to a corresponding value typically less than half the sampling frequency, to obtain optimum out-of-band signal rejection.

System 816 is ideally suited to automated data acquisition and signal processing in such fields as sonar, vibration, speech, medicine, geophysics, and process control.

System 816 consists of a mainframe and a number of plug-in filter cards. The mainframe provides local, on-card, and remote programming, readout facilities, power, and input/output connections for up to 16 independent channels. One filter card is required for each channel. The user may thus purchase the mainframe and as many filter cards as initially required. System 816 may then be expanded in the future by purchasing additional filter cards.

This manual contains complete specifications, installation and operation instructions, theory of operation, maintenance and calibration procedures, an electrical parts list, and component location and schematic illustrations.

BUTTERWORTH. The Butterworth filter has maximally-flat amplitude response suitable for frequency-domain applications. Its cutoff frequency (fc) is defined as the frequency at which the amplitude response is down 3 db. The attenuation rate (rolloff) beyond the cutoff frequency is 48 db/octave.

BESSEL. The Bessel filter is a linear-phase filter. Because of this characteristic the filter approximates a constant time delay up to its cutoff frequency. This filter is suitable for time-domain applications because of its inherent ability to pass transient waveforms with a minimum of distortion and overshoot. Cutoff frequency (fc) of an 8th-order Bessel filter is defined as the frequency at which the phase shift is equal to 360°; its amplitude response is down 3 db at 0.5 fc.

1-2. DESCRIPTION.

ELECTRICAL. System 816 operates from either 115 or 230 volts ac, 50-60 Hz, and consumes 200 watts maximum power. A rear-panel slide switch selects the nominal line voltage. A fan draws air through the instrument for cooling. The case of the instrument is grounded through the power cord, but signal and programming ground is isolated from the case through a .47 uF capacitor. Cutoff frequency is set by an 8-4-2-1 code which selects the units, and a one-of-four decade multiplier. Channel selection is made by 8-4-2-1 code. Filter cards contain two memories, each of which stores the 8 bits necessary to specify the cutoff frequency. One of the memories consists of eight miniature switches mounted on the filter card. By setting these switches to a particular frequency value, a frequently-needed setting is stored in a non-volatile form. The other memory consists of digital registers which can be loaded either by front-panel toggle switches or remote-

programming lines. With PRESET selected (either front panel or programming) the filter cutoff frequency is determined by the on-card switch memory. When PRESET is not selected (NORMAL) the filter cutoff frequency is determined by the data loaded into the digital registers. The cutoff frequency stored in the digital registers can either be loaded into any one selected channel, or into all channels in common. When power to the unit is turned on, the digital registers are automatically loaded to their highest cutoff frequency.

Except for POWER, all controls (CUTOFF FREQUENCY, CHANNEL SELECT, COMMON/LOAD, PRESET/NORMAL, and REMOTE/LOCAL) can be set either by front-panel toggle switches or through programming lines connected to a rear-panel connector. Red light-emitting diodes (LEDs) located above each toggle switch indicate COMMON, PRESET, and/or REMOTE operation, as well as the channel selected at the front panel and the cutoff frequency of that channel.

PHYSICAL. The System 816 cabinet is 5-1/4 inches high by 17 inches wide (19 inches including rack mounts). The instrument is 19 inches deep behind the rack mounts and 20-3/4 inches deep overall. Weight with no filter cards installed is 24-1/2 pounds. Filter cards weigh approximately 1 pound each.

The POWER switch and all operating controls and indicators are located at the front panel. The rear panel contains the fan intake and exhaust vents, power connector and fuse holder, 115/230 VAC line selector switch, one 36-pin programming connector, and two 36-pin signal connectors. The mating connectors for signal and programming are fastened in place when shipped from the factory.

Most of the electrical components are mounted on two printed-circuit boards, in addition to the filter cards. The motherboard holds power supply components and sockets for the plug-in front-panel scanner assembly and all the plug-in filter cards. Etched fingers at the rear of the motherboard accommodate the programming and signal connectors through the rear panel. The scanner assembly, mounted directly behind the front panel, holds the control circuits and the front-panel toggle switches and indicators. The front panel and scanner assembly remove easily for service.

As many as sixteen filter cards can be installed in each System 816 mainframe. Card extractors mounted on each filter card simplify insertion and extraction. Two miniature-switch assemblies, each containing four switches, are mounted on each card for setting PRESET cutoff frequency. These switches are factory-set at their highest frequency value. Eight pairs of miniature plug-in jumpers on Butterworth cards allow the filter cards to be set individually for low-pass or high-pass filtering. Cards are shipped from the factory in low-pass configuration. Bessel cards are hard wired for low-pass filtering only.

1-3. OPTIONS.

System 816 filter cards are available in four overlapping frequency ranges. Table 1-1 lists the option numbers for each range for the mainframe and both the Butterworth and Bessel filter cards. The only differences in mainframes are the front-panel MULTIPLIER markings. Cards with different frequency ranges may be used in a common mainframe, but this fact must be suitably noted by the user in his software or operating instructions. The overall frequency range of each of the filter cards consists of four ranges which are selectable by the CUTOFF FREQUENCY controls. (These four ranges are designated A-B-C-D in this manual.) Table 1-2 lists the frequency settings possible with each card. Each option number has four ranges listed below it.

Table 1-1. Frequency Range Options.

Mainframe	Filter Cards Butterworth	Bessel	Overall Frequency Range
11	01	05	10 Hz to 150 KHz
12	02	06	1 Hz to 15 KHz
13	03	07	0.1 Hz to 1.5 KHz
14	04	N.A.	0.01 Hz to 150 Hz

Table 1-2. Nominal Cutoff Frequency (Hz).

OPTIONS 04, 14	OPTIONS 03, 07, 13	OPTIONS 02, 06, 12	OPTIONS 01, 05, 11			
0.01	0.1	1	10	100	1K	10K
0.02	0.2	2	20	200	2K	20K
0.03	0.3	3	30	300	3K	30K
0.04	0.4	4	40	400	4K	40K
0.05	0.5	5	50	500	5K	50K
0.06	0.6	6	60	600	6K	60K
0.07	0.7	7	70	700	7K	70K
0.08	0.8	8	80	800	8K	80K
0.09	0.9	9	90	900	9K	90K
0.10	1.0	10	100	1K	10K	100K
0.11	1.1	11	110	1.1K	11K	110K
0.12	1.2	12	120	1.2K	12K	120K
0.13	1.3	13	130	1.3K	13K	130K
0.14	1.4	14	140	1.4K	14K	140K
0.15	1.5	15	150	1.5K	15K	150K

1-4. SPECIFICATIONS.

Typical Butterworth and Bessel filter characteristics are given in Table 1-3. Figures 1-2 and 1-3 are graphs of typical amplitude and phase responses. Table 1-4 provides operating specifications for System 816.

Table 1-3. Typical Characteristics.

Butterworth Low-Pass Transfer Function:

Frequency	Amplitude	Phase
DC	0 db	0°
$\sqrt{2}/2$ fc	0 db	-220°
fc	-3 db	-360°
$\sqrt{2}$ fc	-24 db	-495°
2 fc	-48 db	-570°

Butterworth High-Pass Response: mirror image of low-pass response except for highest MULTIPLIER range (not recommended for high-pass operation)

Bessel Low-Pass Transfer Function:

Frequency	Amplitude	Phase
DC	0 db	0°
0.25 fc	-0.7 db	-90°
0.5 fc	-3 db	-180°
0.75 fc	-7 db	-270°
fc	-13.6 db	-360°

	Butterworth	Bessel
Peak Overshoot:	16%	0.5%
Settling Time (plus 3 mSec programming time):		
To $\pm$ 1% of final value	3.1/fc	1.6/fc
To $\pm$ 0.1% of final value	5.1/fc	2.3/fc
To $\pm$ 0.01% of final value	7.1/fc	3.2/fc

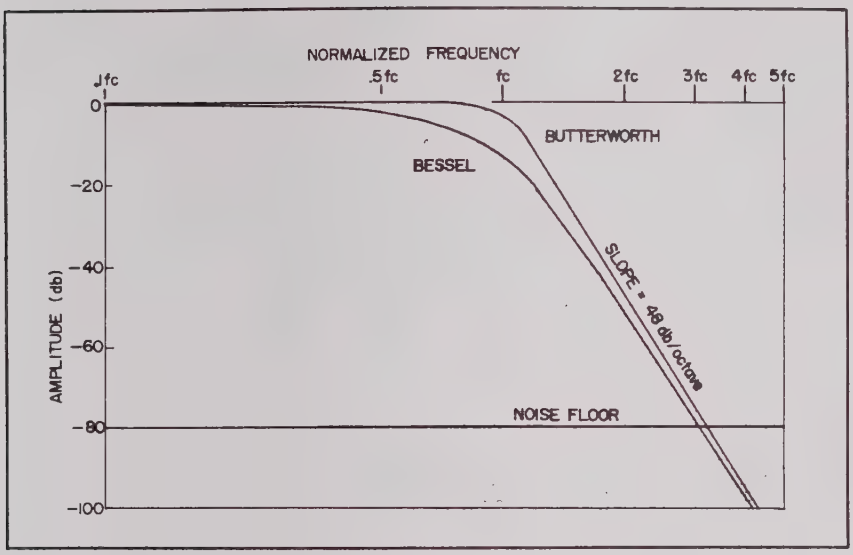


Figure 1-2. Typical Amplitude Response.

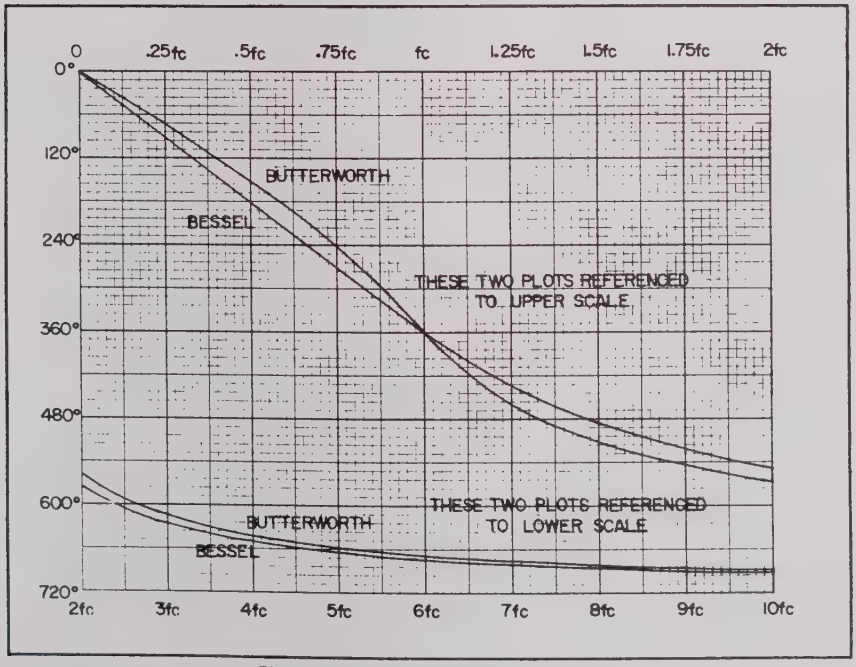


Figure 1-3. Typical Phase Response.

Table 1-4. Specifications.

CUTOFF FREQUENCY

Resolution: cutoff frequency units may be programmed to fifteen discrete values, from 1 to 15

Range: four multiplier ranges may be programmed (see Table 1-1). The cutoff frequency in Hertz is the product of the Units setting and the Multiplier setting.

Accuracy: ± 2%, (± 3% in highest multiplier position)

Stability: ± 200 ppm°C (typical)

DC GAIN

0 db ± 0.25 db

TYPICAL PHASE MATCH BETWEEN FILTER CARDS

± 2° or ± 2%, whichever is greater.

INPUT CHARACTERISTICS

Circuit: single ended, DC isolated from chassis

Impedance: 1 megohm shunted by 50 pF

Full-Scale Signal: ± 10 volts (20 V, pk-pk)

Absolute Maximum Input: ± 100 volts (AC + DC)

OUTPUT CHARACTERISTICS

Circuit: single ended, DC isolated from chassis

Impedance: 50 ohms

Full-Scale Signal: ± 10 volts (20 V, pk-pk)

Output Current: ± 20 mA into 50 ohms (typical)

Distortion: less than 0.1%

Noise and Hum (including Crosstalk): 80 dB below full-scale signal with inputs shorted and 100 KHz detector bandwidth.

DC Offset: 0 ± 10 millivolts at any f_c setting.

Drift: 0.5 mV/°C, typical

Table 1-4. Specifications (Cont).

REMOTE PROGRAMMING

Requires a maximum of 17 bits (lines) for full programming of the 16-channel system as follows:

Four bits select channel to be programmed

Four bits select cutoff frequency units

Four bits select cutoff frequency range multiplier

One bit each for Device Select, Common Program, Load Command, Preset Command, and Load Acknowledge

All input lines represent two standard TTL loads. Each line is terminated with a 3.3K pull-up resistor to +5 V DC. An unconnected (open) line will assume logic "0" (high)

Inverted TTL Logic Levels:

logic "1" is 0.0 V to +0.8 V (low)

logic "0" is +2.0 V to +5.0 V (high)

Cutoff Frequency Units: four lines, 8-4-2-1 code, selected by logic "1"

Cutoff Frequency Multiplier: four lines, selected by logic "1", weight dependent on frequency range of card being programmed

10 Hz to 150 KHz card	X10	X100	X1K	X10K
1 Hz to 15 KHz card	X1	X10	X100	X1K
0.1 Hz to 1.5 KHz card	X0.1	X1	X10	X100
0.01 Hz to 150 Hz card	X0.01	X0.1	X1	X10

If two or more Multiplier values are programmed, the highest programmed value operates.

Channel Select: four lines, 8-4-2-1 code, selected by logic "1"

Device Select: one line, low selects remote-program control, high selects front-panel control

Table 1-4. Specifications (Cont).

Common Program: one line, low allows Load only to channel determined by Channel Select lines, high selects identical loading of all channels

Load Command: one line; normally held high, low loads Cutoff Frequency data. When held high all Cutoff Frequency data which has been loaded is stored internally; programming inputs need not be held constant.

Preset Command: one line; normally held high, low enables on-card cutoff-frequency switch control of fc and disables digital register control of fc (digital registers can still be loaded)

Load Acknowledge (Output): one line, normally high. Pulled low through the collector of an NPN transistor to indicate to the programmer that data has been loaded, and remains low as long as both Device Select and Load Command are low.

Programming Delay: less than 3 mS for any function

ELECTRICAL AND PHYSICAL CHARACTERISTICS

Primary Power: 115 or 230 VAC $\pm$ 10%, 50-60 Hz, 200 watts maximum (with 16 filter cards installed)

Dimensions: cabinet is 5-1/4 inches (13.3 cm) high, 17 inches (43.2 cm) wide, 19 inches (48.3 cm) deep; mounts in standard RETMA rack. Depth behind rack mount is 19 inches (48.3 cm) including rear-panel components.

Weight: mainframe, 24-1/2 lb (11.14 kg); filter cards, each 1 lb (0.45 kg)

Operating Temperature: 0°C to +50°C ambient

Storage Temperature: -20°C to +70°C

Connectors: all input, output, and programming connections are made at the rear panel via three p.c.-edge connectors. Mating connectors (CINCH-JONES No. 50-36A-30) are supplied with the mainframe.

SECTION II
OPERATION

2-1. INTRODUCTION.

System 816 is electrically operational as shipped from the factory. The following paragraphs describe inspection, power requirements, interconnection, and operation.

2-2. INSPECTION.

This system was carefully inspected and tested prior to shipment. It was operated for a number of hours to reduce the probability of early failure. After unpacking the unit, it should be carefully inspected for shipping damage. Check especially for broken controls and connectors, and dented or scratched cabinet parts. Should the instrument show any signs of damage, file a claim with the carrier immediately. Preserve the carton and packing materials; they will be required by the carrier.

It is recommended that conformance to specifications be verified upon receipt. In case of discrepancies, refer to the warranty at the beginning of this manual.

2-3. INSTALLATION AND POWER REQUIREMENTS.

System 816 is designed primarily for installation in a standard 19-inch RETMA rack. Depth of the rack should be at least 22 inches to allow 3 inches minimum behind the instrument for cables and ventilation. Ambient temperature within the rack must not exceed +50°C while the instrument is operating. Other paragraphs in this section describe connections and switch settings which should be made before the unit is installed.

CAUTION

Always ensure that the 115/230 volt switch is set for the nominal line voltage and that a fuse of the proper

rating is installed in the instrument. If the switch is set incorrectly or a fuse of the wrong rating is used, the instrument may be damaged or fail to operate.

The instrument will operate from either 115 or 230 volts ac, 50-60 Hz. Conversion for line voltage is performed with a slide switch mounted on the rear panel (see Figure 2-1). The unit is shipped with the switch set for 115 volts. To change the setting, insert a small-blade screwdriver in the switch slot and move switch to expose 115 for 115 Vac operation, or 230 for 230 Vac operation.

The instrument is shipped with a 2-amp slow-blow fuse for 115-volt operation. If the unit is to be operated from a 230-volt supply, the fuse should be replaced with a 1-amp slow-blow fuse (not supplied).

WARNING

In keeping with standard safety practice, the case of the instrument is grounded through the power cord. If the instrument must be connected to a two-wire receptacle, use a parallel-ground adapter and connect the short lead to ground.

2-4. CONTROLS AND INDICATORS.

System 816 controls and indicators are shown in Figure 2-1 and described in Table 2-1. The descriptions in Table 2-1 and the following paragraphs are not intended to be complete operating instructions, but only general information applying to all modes of operation. Paragraphs 2-5, 2-6, and 2-7 describe filter-card settings, interconnection, and typical operating procedures.

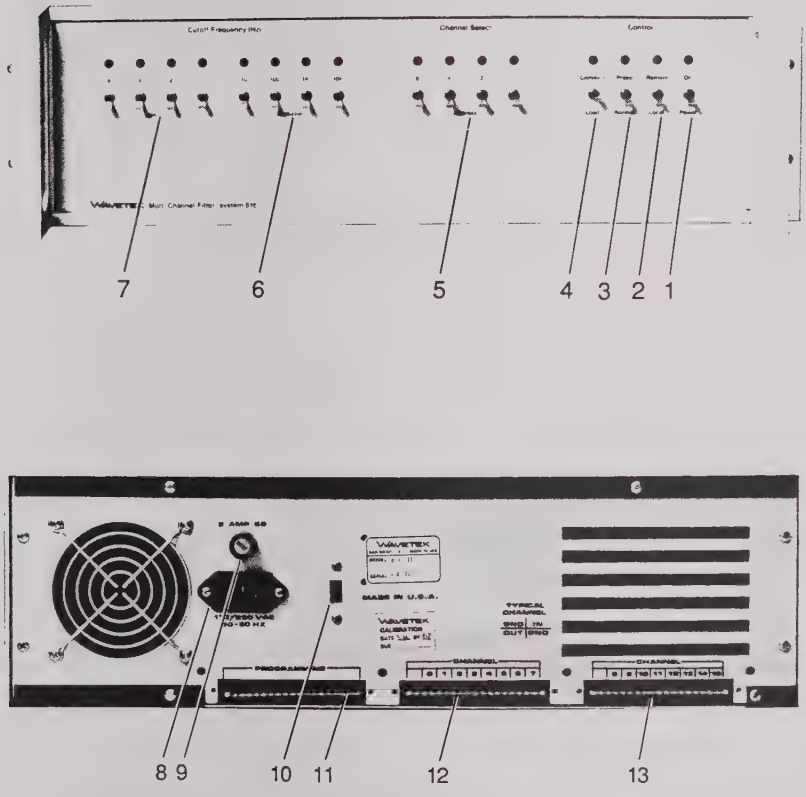


Figure 2-1. Controls and Indicators.

Table 2-1. Controls And Indicators.

NUMBER	ITEM	DESCRIPTION
1	POWER ON Switch	A two-position toggle switch which supplies power to the instrument. The digital register memories on all filter cards are loaded to their highest cutoff-frequency value when power is turned on. A red light-emitting diode (LED) located above the switch indicates that power is on.
2	LOCAL/REMOTE Switch	A two-position toggle switch; in LOCAL the unit is controlled by front-panel switches, in REMOTE the unit is controlled by programming commands through the rear-panel PROGRAMMING Connector. With this switch at LOCAL, remote control can still be selected via the PROGRAMMING Connector. A red LED indicates REMOTE control, whether selected at the front panel or remotely.
3	NORMAL/PRESET Switch	A two-position toggle switch; in NORMAL the cutoff frequency is controlled by digital registers on each filter card. These registers can be

Table 2-1. Controls And Indicators (Cont).

NUMBER	ITEM	DESCRIPTION
		loaded either by front-panel switches or remote-programming lines. In PRESET the cutoff frequency is set by switches on each filter card. A frequently-used program can be stored with the on-card switches, eliminating the need to reprogram the digital register each time the instrument is turned on. With switch at NORMAL, PRESET can still be selected via the PROGRAMMING Connector. A red LED indicates PRESET operation, whether selected at the front panel or remotely.
4	LOAD/COMMON Switch	A three-position toggle switch, normally in the middle (off) position. In the momentary-contact LOAD position cutoff-frequency data is loaded into the digital register of a single selected channel. In COMMON, all channels are loaded at the same time; the digital registers follow the front-panel switch settings as long as the switch is left in COMMON. A red LED indicates COMMON.

Table 2-1. Controls And Indicators (Cont).

NUMBER	ITEM	DESCRIPTION
5	CHANNEL SELECT Switches	Four two-position toggle switches which select the channel (0–15) whose cutoff frequency is to be set by a front-panel LOAD command. In REMOTE (or LOCAL) operation, the cutoff frequency displayed on the front panel is that of the channel selected by the CHANNEL SELECT Switches. Four red LEDs indicate the address of the selected channel in 8–4–2–1 code.
6	CUTOFF FREQUENCY MULTIPLIER Switches	Four two-position toggle switches which select one of four overlapping frequency ranges. If more than one multiplier is selected, only the highest selected value operates (see Table 2-2). Four red LEDs indicate the range of the filter card selected by the CHANNEL SELECT Switches, whether that range is set by the on-card switches, at the front panel, or remotely.

Table 2-1. Controls And Indicators (Cont).

NUMBER	ITEM	DESCRIPTION
7	CUTOFF FREQUENCY UNITS Switches	Four two-position toggle switches which select the units of the cutoff frequency in Hertz (see Table 2-2). Four red LEDs indicate the cutoff frequency units (in 8-4-2-1 code) of the filter card selected by the CHANNEL SELECT Switches, whether that value is set by the on-card switches, at the front panel, or remotely.
8	Power Connector	Supplies primary power and grounds the chassis of the instrument.
9	Fuse Holder	Holds power-line fuse; 2-amp slow-blow for 115 V, 1-amp slow-blow for 230 V.
10	115/230 Volt Switch	Sets the instrument for the nominal line voltage.
11	PROGRAMMING Connector	A 36-pin connector used to connect programming signals to System 816 (see Table 2-5).
12 & 13	CHANNEL Connectors	Two 36-pin connectors used to make signal input and output connections (see Tables 2-3 and 2-4).

CHANNEL SELECTION. Channels are numbered 0 through 15, and are selected in 8-4-2-1 code as shown in Table 2-2a.

CUTOFF FREQUENCY SETTING. Table 2-2 lists the codes which select the CUTOFF FREQUENCY UNITS and MULTIPLIER. In LOCAL (front-panel) control, "1" is selected by setting the toggle switch to its upper position, toward the selected unit or multiplier range. Tables 1-3 and 2-5 provide data concerning the signal levels of the "1" (active) state for REMOTE control.

NOTES

A UNITS value of "0" (zero) should be avoided. Selecting a UNITS value of "0" will saturate the filter amplifiers.

It is recommended that the highest MULTIPLIER range (D) not be used in high-pass configuration.

It can be seen from Table 2-2 that if more than one multiplier range is selected, either at the front panel or remotely, only the highest selected range operates. This means that two ranges can be controlled by one switch or programming line. For example, selection between the B and D ranges can be made by selecting both ranges. When D range is needed, leave both ranges on, and only the D range operates. When B range is needed, simply turn the D range off and B range will then operate.

NOTE

Only one MULTIPLIER range may be selected by the on-card PRESET Switches. The other three ranges must be turned off.

Table 2-2. CUTOFF FREQUENCY And CHANNEL SELECT Switch Settings.

a. CUTOFF FREQUENCY UNITS And CHANNEL SELECT

CHANNEL	CUTOFF FREQUENCY (Hz) UNITS	CODE 8-4-2-1
0	AVOID	0 0 0 0
1	1	0 0 0 1
2	2	0 0 1 0
3	3	0 0 1 1
4	4	0 1 0 0
5	5	0 1 0 1
6	6	0 1 1 0
7	7	0 1 1 1
8	8	1 0 0 0
9	9	1 0 0 1
10	10	1 0 1 0
11	11	1 0 1 1
12	12	1 1 0 0
13	13	1 1 0 1
14	14	1 1 1 0
15	15*	1 1 1 1
	*This setting should also be used when the filter is operated as a DC Amplifier	

b. CUTOFF FREQUENCY MULTIPLIER

CUTOFF FREQUENCY (Hz) MULTIPLIER	CODE
DC AMPLIFIER*	0 0 0 0
A	0 0 0 1
B	0 0 1 X
C	0 1 X X
D**	1 X X X

X=either 0 or 1 except for the on-card PRESET Switches. For these switches only one range can be selected, the others must be switched off.

* Filter cards may be operated as DC Amplifiers only in low-pass configuration, avoid this setting in high-pass configuration.

** Avoid this setting in high-pass configuration.

Certain values of cutoff frequency can be obtained by either of two combinations of switch settings. For instance, 1 KHz can be obtained with a UNITS value of 1 and a range MULTIPLIER of X1000, or with a UNITS value of 10 and a range MULTIPLIER of X100. Generally it is recommended to use the higher UNITS value and the lower MULTIPLIER (UNITS of 10, MULTIPLIER of X100 in this example).

SETTLING TIME. The longest settling time of the filters occurs when switching to the lowest MULTIPLIER range (A). To obtain fastest settling when switching to a lower MULTIPLIER, proceed as follows:

1. Select desired MULTIPLIER range.
2. Temporarily select a UNITS value of 15.
3. Select desired UNITS value.

SPECIAL MODES. Filter bypass can be obtained by selecting no MULTIPLIER range. In this configuration the filter operates as a DC amplifier with unity gain. A UNITS value of 15 should be selected to minimize noise pickup. Either Butterworth or Bessel filter cards can be used as DC amplifiers, but the Butterworth card must be set for low-pass operation.

INDICATORS. The LEDs above the CUTOFF FREQUENCY toggle switches indicate the cutoff frequency of the channel selected by the front-panel toggle switches. Therefore, changing the CUTOFF FREQUENCY Switches will not affect the cutoff frequency (hence, the LEDs) until receipt of a LOAD Command or unless COMMON is selected. The LEDs will not light if there is no filter card in the selected channel.

The LEDs above the CHANNEL SELECT Switches indicate the address of the channel selected by the front-panel switches only.

2-5. FILTER CARD SETTINGS AND INSTALLATION.

ON-CARD CUTOFF FREQUENCY SWITCHES. Figure 2-2 shows the location of the on-card switches which set the cutoff frequency in PRESET mode. Cards are shipped with a units value of 15 and the highest multiplier range selected.

To set the units, slide the switches to the right to select units from 1 to 15 as required. The example in Figure 2-2b shows a units value of 13 selected; the 8, 4, and 1 switches are set to the right, toward the numbers etched on the printed-circuit board.

To set the multiplier, set the desired switch to the left, toward the multiplier range value printed on the label to the left of the switches. The example in Figure 2-2a shows a multiplier value of X100 selected on a filter card having an overall frequency range of 10 Hz to 150 KHz. Filter cards in other frequency ranges have labels which correspond to the range of the card. Unlike operation in LOCAL and REMOTE modes, only one multiplier range may be selected; the other ranges must be turned off.

LOW PASS/HIGH PASS JUMPERS. On Butterworth filter cards eight pairs of plug-in jumpers on each card determine low-pass or high-pass operation. (Cards are shipped in low-pass configuration. Bessel filter cards are hard-wired for low-pass operation only.) Figure 2-3 shows the locations of the jumpers. Each jumper set consists of five jacks soldered to the filter card in a "W"-shaped pattern, and two jumper plugs. For explanation purposes, the pins are designated a, b, c, d, e in Figure 2-3a. For low-pass operation, connect pin a to pin c and pin b to pin d. For high-pass operation, connect pin a to pin d and pin b to pin a.

NOTE

All eight jumper sets on any one card must be set in the same way, either low-pass or high-pass.

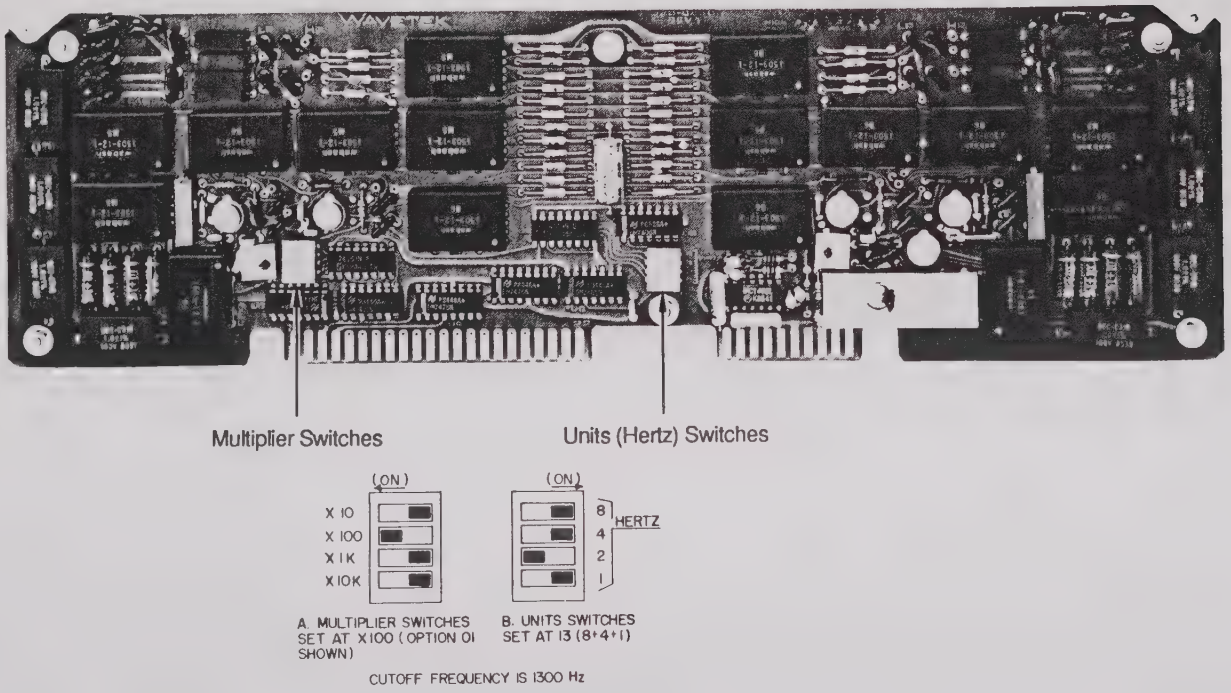
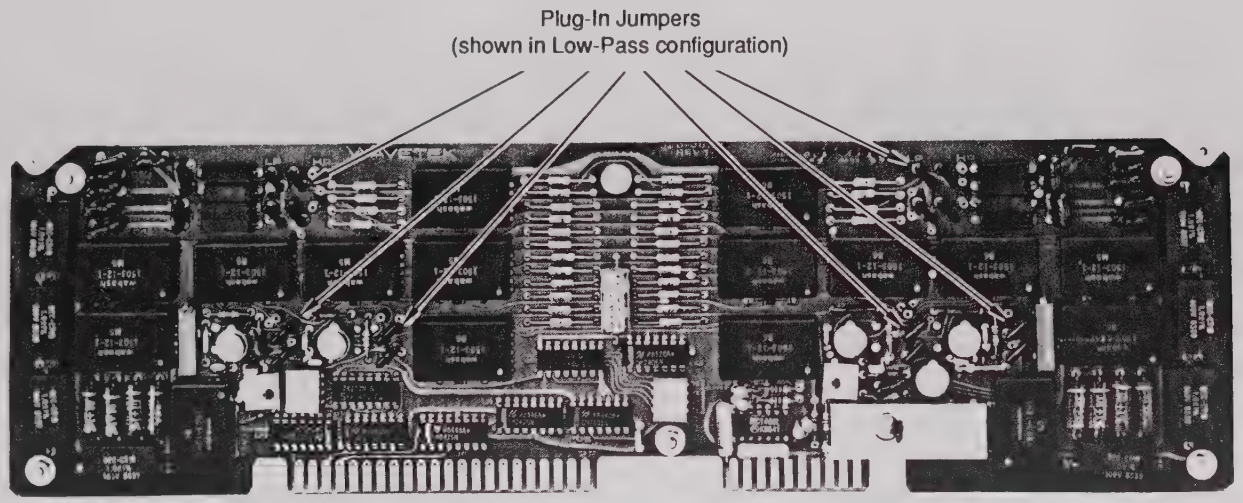


Figure 2-2. On-Card (Preset) Cutoff Frequency Switches.



A. JUMPER PINS (LETTERS ARE NOT ON PRINTED-CIRCUIT BOARD)

B. ONE PAIR OF JUMPERS IN LOW-PASS CONFIGURATION

C. ONE PAIR OF JUMPERS IN HIGH-PASS CONFIGURATION

Figure 2-3. Plug-In Jumpers For Low Pass/High Pass.

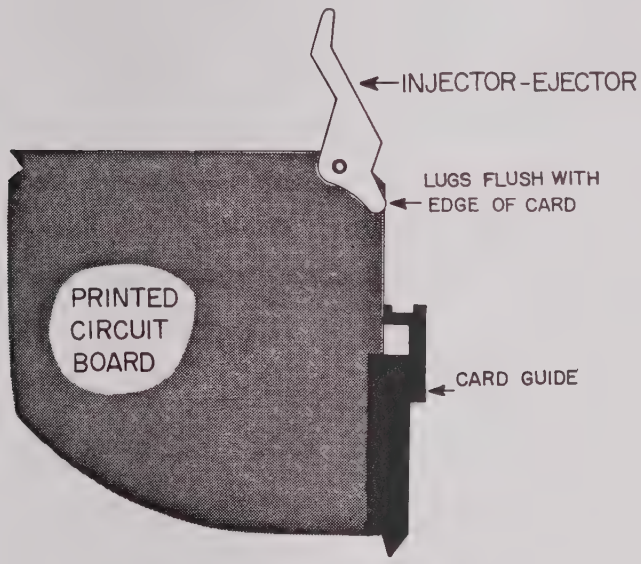
INSTALLATION.

WARNING

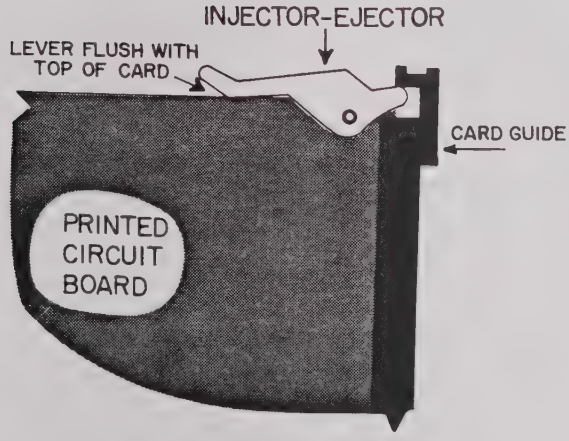
Exposed electrical connections within the instrument may connect to potentially dangerous voltages, even when the POWER Switch is turned off. Exercise caution when working within any electrical equipment.

Filter Cards are installed with the component side facing to the right of the instrument. Channel numbers are etched on the motherboard adjacent to the rear socket for each filter card. A filter card may be installed in any channel; cards need not be installed sequentially. To install filter cards in System 816, proceed as follows (see Figure 2-4):

1. Remove two screws which secure the top cover to the rear panel, and slide the top cover to the rear.
2. Position injector-ejectors on each side of card so that engaging lugs are flush with side edge of card (Figure 2-4a).
3. Slide card into guide slots for desired channel.
4. Ensure that printed-circuit board contacts are properly aligned with both sockets on the motherboard.
5. Push both injector-ejector levers down at the same time to lock the card in place (Figure 2-4b). With the levers flush with the top of the card, press down on both injector-ejectors to ensure that card is fully seated.
6. To remove a card, pull both injector-ejector levers up at the same time to unseat the card.



a. Injector-Ejector Set for Insertion.



b. Filter Card Locked in Place.

Figure 2-4. Filter Card Installation.

2-6. INTERCONNECTION.

SIGNAL. All input and output signal connections are made through two rear-panel connectors. The connectors are printed-circuit edge type, with 18 contacts on the top edge, and 18 on the bottom. Input signal and ground lines alternate on the top row, and output signal and ground lines alternate on the bottom row. Table 2-3 lists the pin connections for the CHANNEL 0-7 Connector, and Table 2-4 lists the pin connections for the CHANNEL 8-15 Connector. Pin designations are, from left to right, 1 to 18 on the top row and A to V on the bottom row.

Signal connections should generally be made with coaxial cable, with the cable shield soldered to the ground pin next to the signal pin. In some applications, where crosstalk or noise pickup is not a serious consideration, twisted pairs may be adequate for signal connections.

PROGRAMMING. Remote programming controls are supplied to System 816 at the rear panel through a printed-circuit edge connector. The connector has two rows of 18 contacts, designated from left to right. The top row of contacts, pins 1 through 18, is used for the programming input and output signals. Programming ground connections are made at any or all of the bottom row of contacts, pins A through V. Table 2-5 lists the pin connections for the PROGRAMMING Connector and provides a description of each signal. Remote programming inputs are low active ("1" state). A "1" is 0V to 0.8V, and a "0" is +2V to +5V.

Programming connections should generally be made through twisted pairs of leads to prevent false data from being loaded through coupling between lines. All the ground lines can be tied together at the programming instrument if necessary. In some applications, with short lead lengths (generally less than 2 feet), twisted pairs may not be necessary.

Cable clamps supplied with the unit may be used to support signal and programming cables.

Table 2-3. CHANNEL 0-7 Signal Connector.

PIN	DESCRIPTION	PIN	DESCRIPTION
1	No Connection	A	No Connection
2	No Connection	B	No Connection
3	Channel 0 Ground (Input)	C	Channel 0 Output
4	Channel 0 Input	D	Channel 0 Ground (Output)
5	Channel 1 Ground (Input)	E	Channel 1 Output
6	Channel 1 Input	F	Channel 1 Ground (Output)
7	Channel 2 Ground (Input)	H	Channel 2 Output
8	Channel 2 Input	J	Channel 2 Ground (Output)
9	Channel 3 Ground (Input)	K	Channel 3 Output
10	Channel 3 Input	L	Channel 3 Ground (Output)
11	Channel 4 Ground (Input)	M	Channel 4 Output
12	Channel 4 Input	N	Channel 4 Ground (Output)
13	Channel 5 Ground (Input)	P	Channel 5 Output
14	Channel 5 Input	R	Channel 5 Ground (Output)
15	Channel 6 Ground (Input)	S	Channel 6 Output
16	Channel 6 Input	T	Channel 6 Ground (Output)
17	Channel 7 Ground (Input)	U	Channel 7 Output
18	Channel 7 Input	V	Channel 7 Ground (Output)

Table 2-4. CHANNEL 8-15 Signal Connector.

PIN	DESCRIPTION	PIN	DESCRIPTION
1	No Connection	A	No Connection
2	No Connection	B	No Connection
3	Channel 8 Ground (Input)	C	Channel 8 Output
4	Channel 8 Input	D	Channel 8 Ground (Output)
5	Channel 9 Ground (Input)	E	Channel 9 Output
6	Channel 9 Input	F	Channel 9 Ground (Output)
7	Channel 10 Ground (Input)	H	Channel 10 Output
8	Channel 10 Input	J	Channel 10 Ground (Output)
9	Channel 11 Ground (Input)	K	Channel 11 Output
10	Channel 11 Input	L	Channel 11 Ground (Output)
11	Channel 12 Ground (Input)	M	Channel 12 Output
12	Channel 12 Input	N	Channel 12 Ground (Output)
13	Channel 13 Ground (Input)	P	Channel 13 Output
14	Channel 13 Input	R	Channel 13 Ground (Output)
15	Channel 14 Ground (Input)	S	Channel 14 Output
16	Channel 14 Input	T	Channel 14 Ground (Output)
17	Channel 15 Ground (Input)	U	Channel 15 Output
18	Channel 15 Input	V	Channel 15 Ground (Output)

Table 2-5. PROGRAMMING Connector.

FUNCTION	PIN	DESCRIPTION
Channel Select 1	1	Low active. Select the channel (0-15), in 8-4-2-1 code, whose cutoff frequency is to be programmed. (The CHANNEL SELECT Indicators are always controlled by the front-panel CHANNEL SELECT Switches.)
Channel Select 2	3	
Channel Select 4	5	
Channel Select 8	7	
Cutoff Frequency 1	10	Low active. Select the cutoff-frequency units (Hertz) in 8-4-2-1 code. The code for 0 is meaningless, and should be avoided.
Cutoff Frequency 2	11	
Cutoff Frequency 4	12	
Cutoff Frequency 8	13	
Multiplier A	14	Low active. Select the cutoff-frequency range multiplier. The weights of A-B-C-D are in a 1-10-100-1000 ratio (see Tables 1-1, 1-2, and 1-4). If no multiplier is selected, the unit operates as a dc amplifier (low-pass configuration only).
Multiplier B	15	
Multiplier C	16	
Multiplier D	17	
Device Select	2	Low active. Enables remote programming independently of the front-panel LOCAL/REMOTE Switch. If left high (open), Remote can still be selected by the LOCAL/REMOTE Switch. The REMOTE Indicator indicates remote control, whether selected by the Device Select line or LOCAL/REMOTE Switch.

Table 2-6. PROGRAMMING Connector (Cont).

FUNCTION	PIN	DESCRIPTION
Preset	4	Low active. Disables cutoff-frequency data set at the front panel or remotely, and enables cutoff-frequency data set by on-card switches. If left high (open), Preset can still be selected by the NORMAL/PRESET Switch. The PRESET Indicator indicates Preset, whether selected by the Preset line or NORMAL/PRESET Switch.
Common Program	6	High active. Allows cutoff-frequency data to be loaded into all channels simultaneously upon receipt of a Load Command. If held low (ground), the Load Command loads data only into the channel selected by the Channel-Select lines. The COMMON Indicator will light only for the duration of Load Command.
Load Command	8	Low active. Loads cutoff-frequency data (units and multiplier) into the digital register of either the selected channel or all channels as determined by Common Program. Cutoff-frequency data is stored while Load Command is high.
Load Acknowledge	9	Low active. This output line, normally high, is pulled low to signal the programmer that data has been loaded; remains low as long as both Device Select and Load Command are active.

NOTE: "Low active" is ground, "high active" is open. Programming ground connections are made on the bottom row of contacts, pins A through V. Both programming and ground connections should be made through A.W.G. #26 wire, or heavier.

2-7. TYPICAL OPERATING PROCEDURES.

OPERATING MODE SELECTION. System 816 operating mode is controlled by two functions, NORMAL/PRESET, and LOCAL/REMOTE (see Table 2-6). Selection of NORMAL or PRESET determines the source of the cutoff frequency operating on the filter card. When NORMAL is selected, fc is determined by the digital registers on each filter card. When PRESET is selected, fc is determined by the miniature switches mounted on each filter card. PRESET can be selected either by the front-panel NORMAL/PRESET Switch or through the PROGRAMMING Connector. The front-panel PRESET Indicator will light whenever PRESET is enabled, either at the front panel or remotely.

Selection of LOCAL or REMOTE determines the input source for the digital registers on each card. When LOCAL is selected, fc data is loaded into the digital registers from the front-panel CUTOFF FREQUENCY Switches. The channel to be loaded is addressed by the front-panel CHANNEL SELECT Switches. When REMOTE is selected, fc data is loaded into the digital registers through eight PROGRAMMING lines, four to select the UNITS in 8-4-2-1 code, and four to select one of four MULTIPLIER ranges. The channel to be loaded is addressed through four PROGRAMMING lines in 8-4-2-1 code. REMOTE can be selected either by the front-panel LOCAL/REMOTE Switch or through the PROGRAMMING Connector. The front-panel REMOTE Indicator will light whenever REMOTE is enabled, either at the front panel or remotely.

Table 2-6. Operating-Mode Control.

Source Of Operating fc				Digital Register Input Source		
Mode	NORMAL/ PRESET Switch	PRESET Line		Mode	LOCAL/ REMOTE Switch	DEVICE SELECT Line
Preset	PRESET	X		Remote	REMOTE	X
	X	Low			X	Low
Normal	NORMAL	High		Local	LOCAL	High
X indicates that setting is irrelevant.						

In REMOTE mode, cutoff frequency data on the PROGRAMMING lines is loaded upon receipt of a Load Command (0.1uS minimum duration). With Common Program activated the cutoff frequency data is loaded into all channels simultaneously upon receipt of the Load Command. In LOCAL mode, cutoff frequency data set by the CUTOFF FREQUENCY Switches is loaded into the selected channel by pressing down the momentary-contact LOAD Switch, or all channels can be loaded with the same cutoff frequency at once by selecting COMMON.

The front-panel CUTOFF FREQUENCY Indicators show the cutoff frequency operating in the channel addressed by the CHANNEL SELECT Switches, regardless of whether that cutoff frequency was loaded locally, remotely, or by the on-card switches.

NOISE LEVEL. Noise in any one filter card is at least 80 db below the full-scale signal level. When multiple filter cards are used, the signal-to-noise ratio may be somewhat degraded. Noise levels are a function of the number of filter cards being interconnected, the type of interconnection (cascade, parallel, or combination), and bandwidth. The -80 db noise floor in Figures 2-5 through 2-9 is shown for reference only.

INCREASING ROLLOFF RATE (BUTTERWORTH). Filter cards can be cascaded to increase rolloff to 96 db per octave. Figure 2-5 provides a block diagram of the filter-card interconnection and the resultant frequency-response plot. Filter cards are cascaded by connecting the output of one channel to the input of another through the rear-panel connectors. Adjacent channels should be used to minimize the length of wire. Do not connect the signal ground pins together.

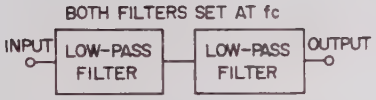
For each filter card cascaded at a given fc, the output signal is down 3 db at fc. Figure 2-5 shows that with two filters, the output signal level is 6 db below the 0 db reference (input signal) level at fc.

BANDPASS FILTERING (BUTTERWORTH). Two filter cards, one in high-pass and one in low-pass, can be cascaded to provide bandpass filtering. Figure 2-6 provides the block diagram and frequency-response plot. When cascading filters for bandpass operation, the input signal should be connected to the high-pass filter, and the output of the high-pass filter is then connected to the input of the low-pass filter. Figure 2-6 shows that with one filter determining each of the two cutoff frequencies the rolloff rate is 48 db/octave.

BAND-REJECT FILTERING (BUTTERWORTH). Two filter cards, one in high-pass and one in low-pass, can be connected in parallel to provide band-reject filtering. Figure 2-7 provides the block diagram and frequency-response plot. Whenever two (or more) filters are connected in parallel, the outputs should be summed through 1K resistors. These should be 1% tolerance, non-inductive, 1/2 watt resistors. Note that this results in a 6 db insertion loss between the input and output signal levels.

DOUBLE BANDPASS FILTERING (BUTTERWORTH). Filters can be cascaded, with the cascades connected in parallel to provide two (or more) passbands. Figure 2-8 provides the block diagram and frequency-response plot for one possible combination of filters. In the example in Figure 2-8, two pairs of filters are used in the top branch to provide a 96 db/octave rolloff for the passband determined by that branch.

DOUBLE BAND-REJECT FILTERING (BUTTERWORTH). Parallel filter configurations can be cascaded to provide two (or more) stopbands. Figure 2-9 provides the block diagram and frequency-response plot for one possible combination of filters. Filters 1 and 2 comprise one band-reject filter, and the summed output is connected to the inputs of filters 3 and 4, which comprise the second band-reject filter. Note that the output reference level is 12 db below the input level.



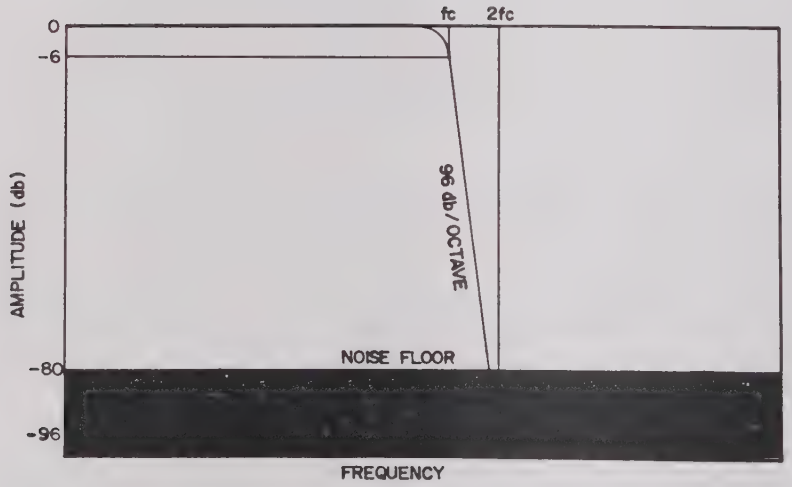
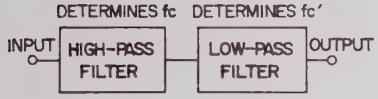


Figure 2-5. Increasing Rolloff Rate.



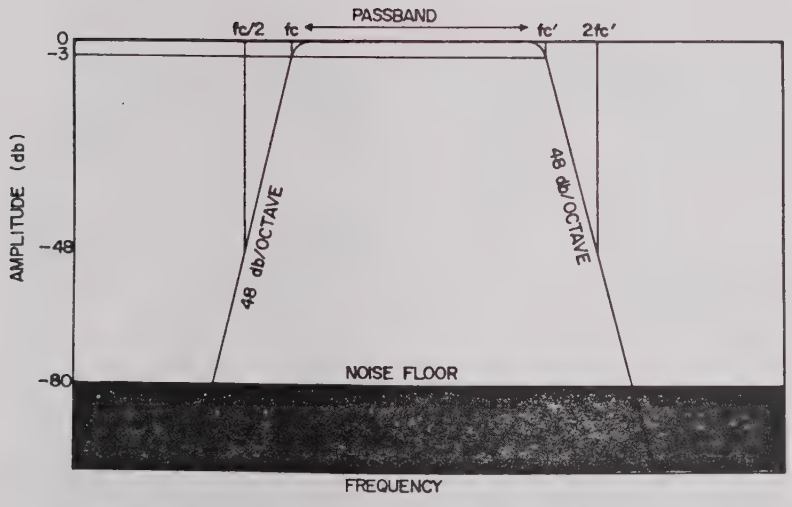


Figure 2-6. Bandpass Filtering.

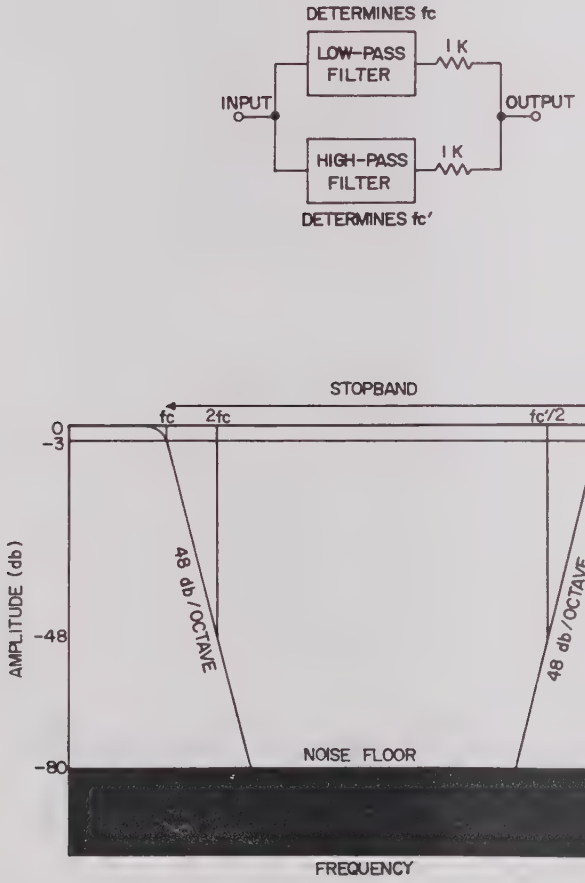
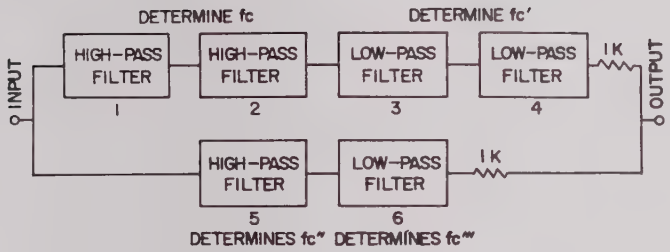


Figure 2-7. Band-Reject Filtering.



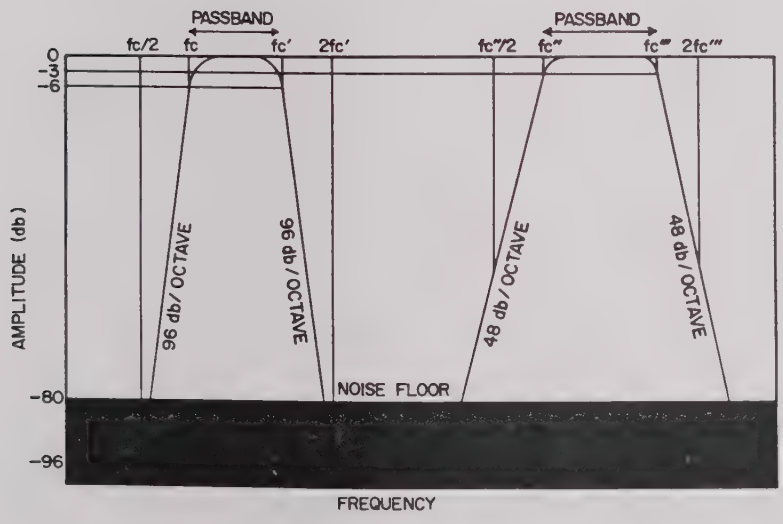
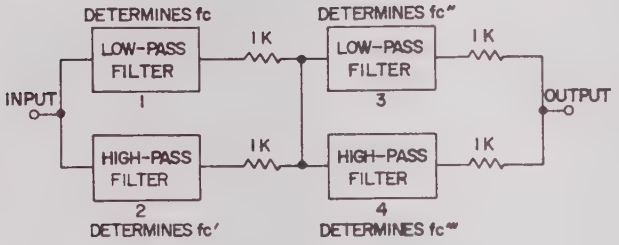


Figure 2-8. Double Bandpass Filtering.



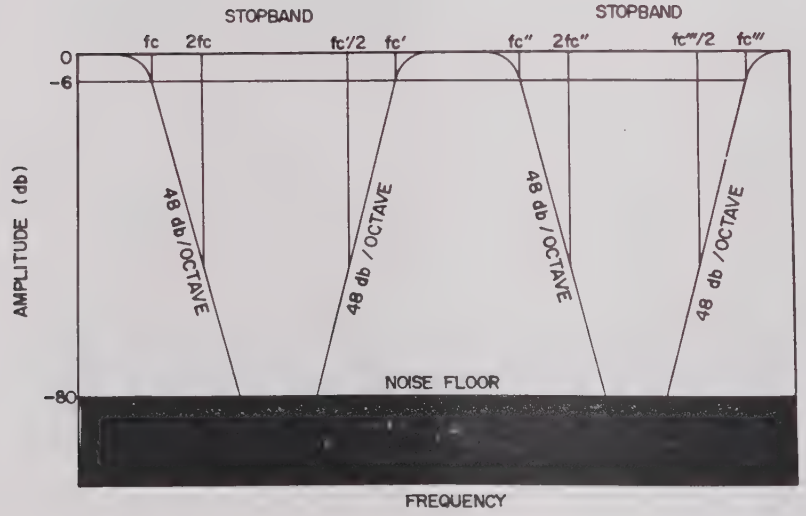
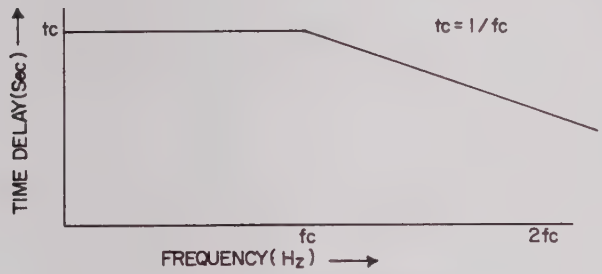
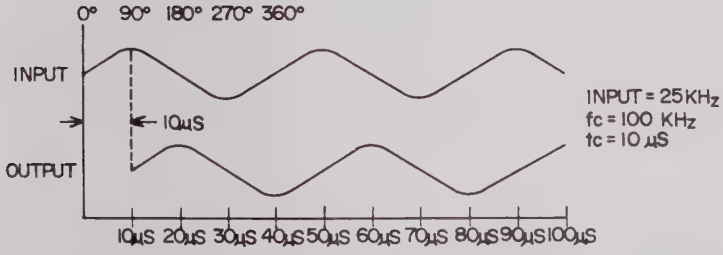


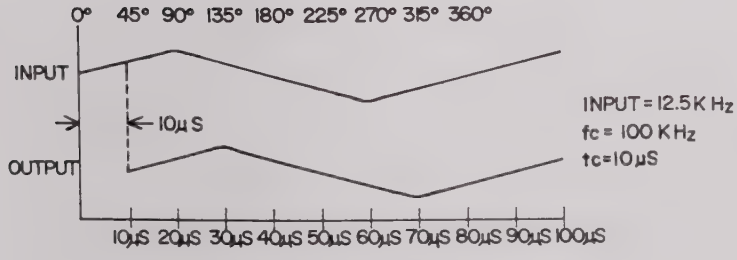
Figure 2-9. Double Band-Reject Filtering.



A. TIME DELAY VS FREQUENCY



B. 25 KHz INPUT



C. 12.5 KHz INPUT

Figure 2-10. Bessel Time Delay.

TIME DELAY (BESSEL). The phase shift of Bessel filters is linear between DC and cutoff frequency (fc). An input frequency equal to fc is shifted 360°, an input frequency equal to 1/2 fc is shifted 180°, an input frequency equal to 1/4 fc is shifted 90°, etc. This linear phase-shift characteristic allows use of Bessel filters as time-delay elements.

Figure 2-10a shows that the time delay (i.e., the derivative of phase) is constant at any fc for input frequencies up to fc. Figures 2-10b and 2-10c show the result of the 10 uS time delay obtained with a cutoff frequency of 100 KHz. The input frequency in Figure 2-10b is 25 KHz, which is 1/4 the cutoff frequency. Therefore, the output is shifted 90° from the input, which is equivalent to 1/4 period, or 10 uS. The input frequency in Figure 2-10c is 12.5 KHz, which is 1/8 the cutoff frequency. Therefore, the output is shifted 45° from the input, which is equivalent to 1/8 period, or 10 uS. Regardless of the input frequency (up to fc), the time delay is always equal to 1/fc.

Two or more filter cards can be cascaded to lengthen the time delay. Note that output signal amplitude decreases as the input frequency approaches fc (see Figure 1-2), which may result in excessive attentuation near fc.

SECTION III

PRINCIPLES OF OPERATION

3-1. INTRODUCTION.

This section contains a block diagram and description of System 816, and a description of the filter card. The block diagram represents the functional operation of the instrument, and does not necessarily show actual circuit configuration. A line on the block diagram or a schematic which is labeled as a signal (e.g., LOCAL, CHANNEL SELECT 8, LOAD ACKNOWLEDGE, etc.) is high (+5 V) whenever that condition is true (operating). A negation symbol (e.g., $\overline{\text{COMMON}}$, CUTOFF FREQUENCY UNITS $\overline{1}$ $\overline{2}$ $\overline{4}$ $\overline{8}$, $\overline{\text{LOAD}}$, etc.) indicates that the signal is low (ground) whenever that condition is true (operating).

3-2. BLOCK DIAGRAM ANALYSIS.

Figure 3-1 is a block diagram of System 816. Switching functions shown are performed by logic circuits. Except for Filter-Card components, all blocks represent components on the Scanner Assembly. In the following paragraphs, reference designations in parentheses are the actual components represented by blocks.

Gate OR1 (U7A) determines whether the instrument responds to front-panel or remote-programming controls. If either front-panel or remote-programming REMOTE is selected, the REMOTE Indicator lights and switch sections a, b, c, and d are set at REMOTE.

Switch "a" (U24 & U27) selects whether the eight Cutoff Frequency bus lines (four Units, four Multiplier) are controlled by the front-panel CUTOFF FREQUENCY Switches or the programming lines.

Switch "b" (U11) selects the source of the channel address for the Load Command, and switch "c" (U9A) selects the source of the Load Command. There are two BCD-to-

Decimal Decoders (U15 & U16), and each one decodes the 1-2-4 BCD data into one of eight channels (0 through 7, or 8 through 15). The Load Gates (U12A, U12B, & U12D) gate the Load Command through to the proper BCD-to Decimal Decoder depending on whether or not the Channel Select "8" line is active.

System 816 also has provision for loading all channels simultaneously. Switch "d" (U9B) selects the source of this control. When selected at the front panel this signal is called Common, and when selected remotely it is called Common Program. Common Program is gated through AND 1 (U1D) only during a remote Load Command, while Common remains as long as the front-panel COMMON/LOAD Switch is at COMMON. Gate OR 2 (U20, U21, U22, & U23) gates the Load Command to one selected channel or to all 16 channels. When a Load Command is supplied to a Filter Card, the data on the eight Cutoff Frequency bus lines is loaded into the Digital Memory (U1 & U4) on that card. Gate OR 3 (U1A) selects whether the data stored on the Digital Memory or the On-Card Switches controls the cutoff frequency. If Preset is selected, either at the front panel or remotely, the PRESET Indicator lights and switch "e" (U2 & U5) is set at PRESET.

The eight inputs to the Relay Drivers are also gated out to light the front-panel CUTOFF FREQUENCY Indicators. The Read Command is supplied to the Memory Data Out Gates (U7 & U8) on only one Filter Card, as selected by the front-panel CHANNEL SELECT Switches through the BCD-to-Decimal Decoder (U13 & U14). The four inputs to this Decoder also light the CHANNEL SELECT Indicators. This enables the operator to read the cutoff frequency of any channel even though automated programming equipment may be controlling System 816.

3-3. FILTER CARD DESCRIPTION.

Figure 3-2 is a simplified schematic of a System 816 filter card. The 8th-order filter consists of an input circuit and four cascaded 2nd-order filter sections. Each 2nd-order section consists of an operational amplifier and feedback and coupling circuits. The

schematic is shown for a low-pass configuration, with a single section shown in high-pass configuration in Insert A. The only difference between low-pass and high-pass consists of the interchanging of the coupling capacitors and resistors.

Although the simplified schematic applies to both Butterworth and Bessel filters, the principles of operation are somewhat different and are described separately. The Butterworth description applies to Bessel filters except as noted in the Bessel description.

BUTTERWORTH FILTER CARDS. The four filter sections of the Butterworth filter are identical, except for component values of R3 and R4. The transfer function for a single section is: $\frac{Vout}{Vin} = A \frac{\omega_0^2}{s^2 + 2\beta\omega_0 s + \omega_0^2}$ where the angular frequency (ω_0) = 1/RC, DC gain (A) = 1 + R3/R4, and damping factor (β) = $1 - \frac{R3}{2R4}$. It can be seen that cutoff frequency is controlled through selection of different RC coupling values, R1, C1, R2, and C2. The resistors are selected by the UNITS controls, and the capacitors are selected by the MULTIPLIER controls.

The damping factor (β) is set by the values of R3 and R4, which are selected to satisfy the mathematic requirements for synthesizing an 8th-order filter with maximally-flat amplitude response (-3 db at fc).

The DC gain (A) is also a function of the values of R3 and R4. The gain of each section is given on the simplified schematic above each section. The total gain for the four sections is approximately 6.88. The combination of the input attenuator and input amplifier provides a gain of $\frac{1}{6.88}$ so that the overall gain from input to output is unity (0 db).

BESSEL FILTER CARDS. The four filter sections of the Bessel filter are not identical, the difference being that each section has a different cutoff frequency as well as a different DC gain. The transfer function for each section is the same as for Butterworth filters: $\frac{Vout}{Vin} = A \frac{\omega_0^2}{s^2 + 2\beta\omega_0 s + \omega_0^2}$ but both angular frequency (ω_0) and damping factor (β) are different for each section. These two parameters are selected to satisfy the mathematic requirements for synthesizing an 8th-order filter with maximally-flat phase shift.

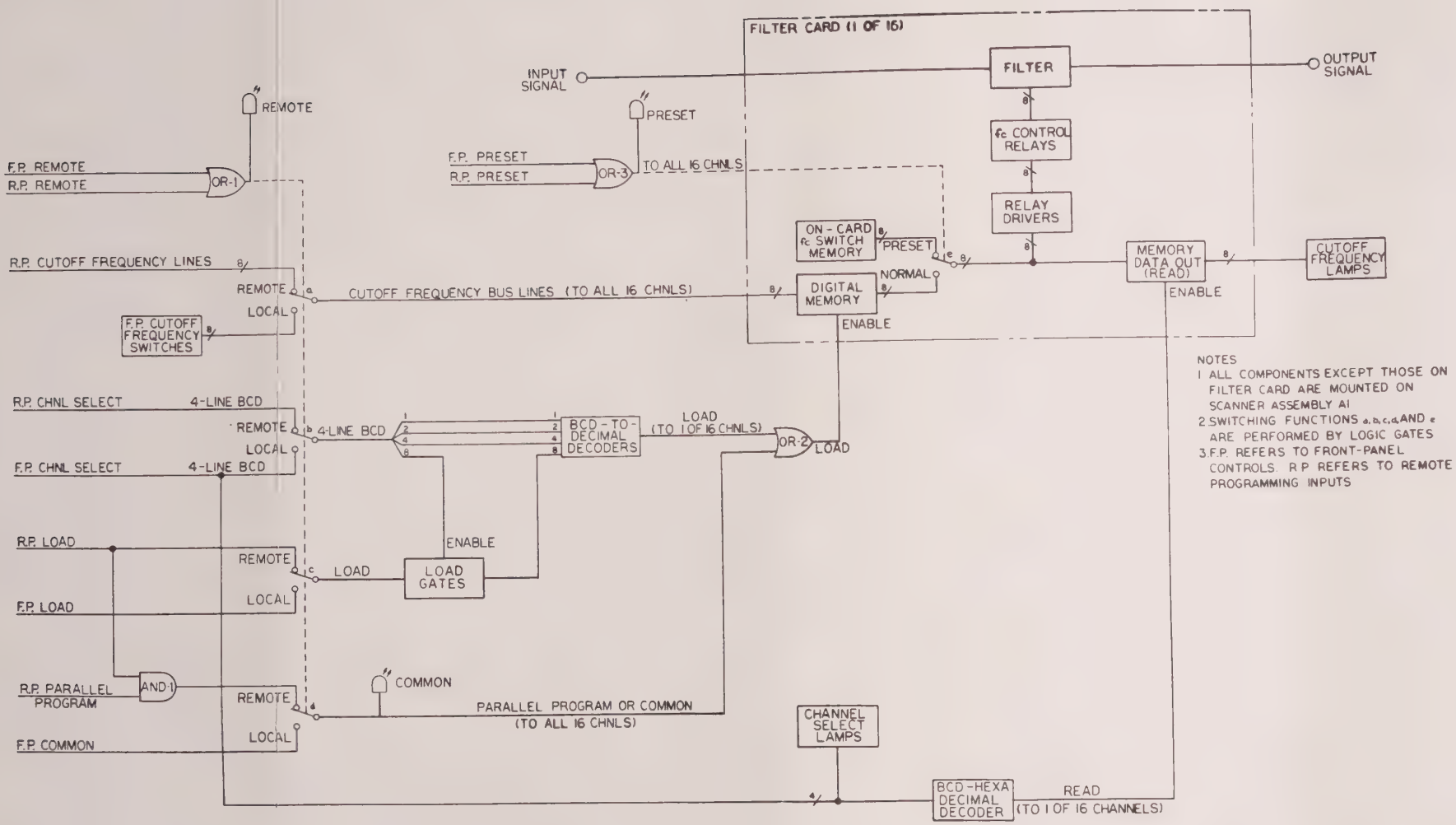


Figure 3-1. System 816 Block Diagram.

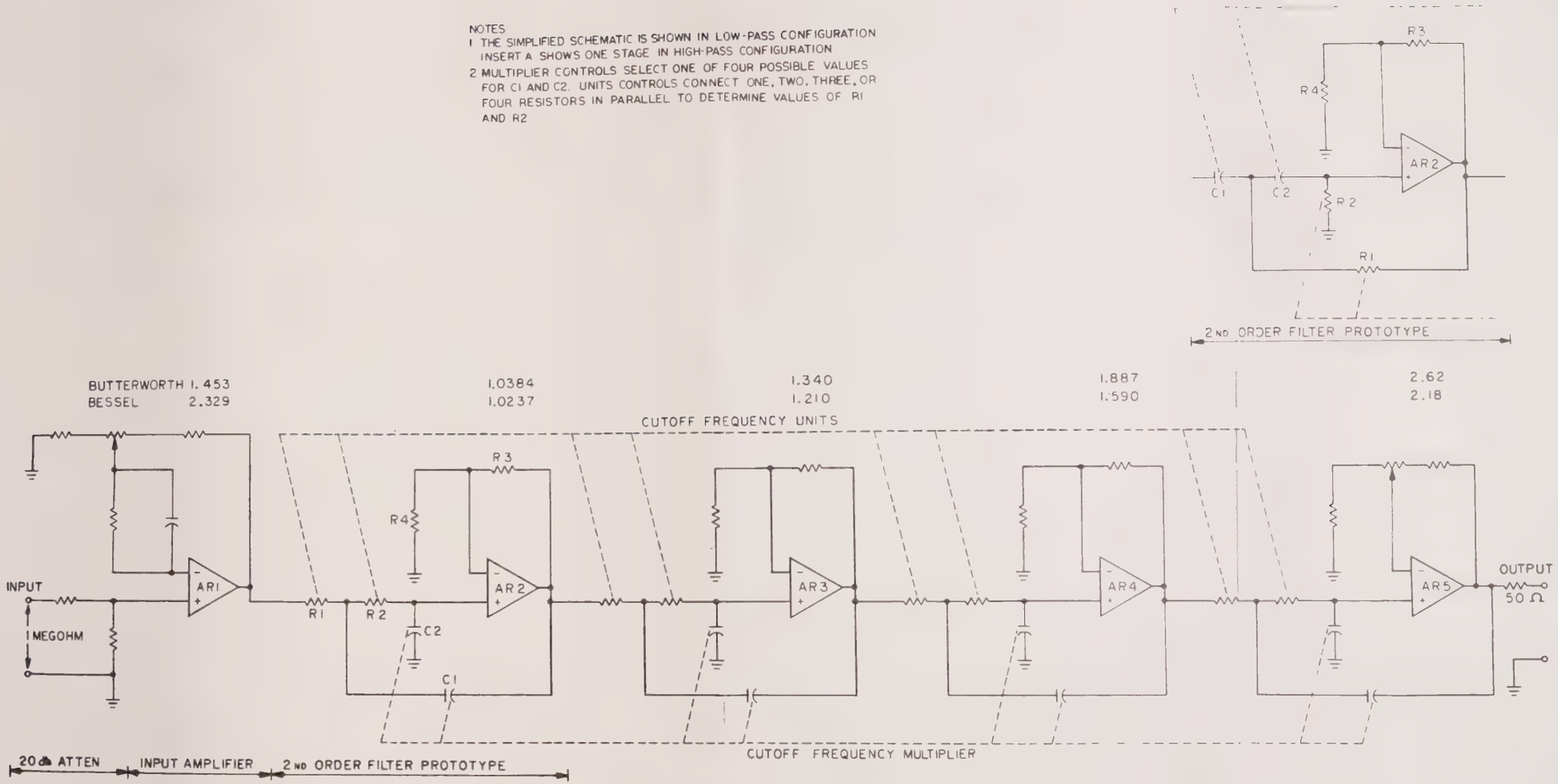


Figure 3-2. Simplified Filter Schematic.

SECTION IV

MAINTENANCE AND CALIBRATION

WARNING

Maintenance may require power on with the INSTRUMENT COVERS REMOVED. This should be done only by service-trained personnel who are aware of the hazards involved such as fire and electrical shock. Where maintenance can be performed without power applied, the power should be removed.

4-1. INTRODUCTION.

Integrated-circuit design and printed-circuit manufacturing techniques utilized in System 816 produce a highly reliable instrument which should seldom require repair or calibration. The fan motor is lubricated for the service life of the instrument. When used in a dusty environment, the interior of the instrument may require periodic cleaning with a vacuum cleaner or dry low-pressure compressed air. The exterior of the instrument can be cleaned with a mild detergent and water solution.

Corrective maintenance consists of procedures designed to correct problems that have resulted in the failure of System 816 to operate properly. Usually these procedures include troubleshooting, repair, and calibration. The test values given in the calibration section may also be used for conformance testing.

4-2. TROUBLESHOOTING.

The single most important aspect of troubleshooting is the formulation of a logical approach to locating the source of trouble. The technician should be familiar with the principles of operation, block diagrams, and schematics. If a malfunction is suspected, ensure that the problem is not caused by other equipment connected to System 816.

Check the fuse, power cord, and all switch settings. Confirm that all eight pairs of jumpers on each filter card are set for low-pass or high-pass operation as required. Check the settings of the on-card cutoff frequency switches, particularly the MULTIPLIER switches; only one MULTIPLIER may be on. Ensure that the proper type of filter, either Butterworth or Bessel, of the proper frequency range is being used. Bessel filter cards can be identified by the hard-wired jumpers in place of the plug-in jumpers used on Butterworth filter

cards. The frequency range of a filter card is given by the label next to the on-card MULTIPLIER switches.

If System 816 is found to be malfunctioning, check to ensure that plug-in assemblies are correctly aligned and fully seated. Look for loose or broken wiring, bent connector pins, leaking capacitors, cracked printed-circuit boards, and discolored components.

System 816 can be separated into digital control circuits and analog signal circuits. A problem can be isolated to one of these two areas by use of the front-panel controls and indicators. (It may be helpful to refer to the System 816 block diagram.) Set a cutoff frequency value and load it into the channel to be checked. If the front-panel LED readout indicates the correct cutoff frequency, all control logic circuits are functioning properly, and the problem must be located in the relay drivers, relays, or filter circuits. If the front-panel readout does not indicate the cutoff frequency that was loaded, the problem must be located in the logic circuits.

ANALOG SIGNAL CIRCUITS. If the problem is isolated to the analog circuits it can be further isolated with the front-panel controls. (Refer to the simplified schematic of the filter card.) The cutoff frequency is controlled by varying the RC coupling between filter stages. The UNITS controls select the resistors, and the MULTIPLIER controls select the capacitors. Select any one MULTIPLIER range and set the UNITS controls for "1". Monitor the output signal to determine the correct attenuation at cutoff frequency (3 db for Butterworth, 13.6 db for Bessel). Repeat the procedure for UNITS values of "2", "4", and "8". If the cutoff frequency is correct in all cases, the coupling resistors and the relays which select them are all functioning properly. Next, select a UNITS value and check the cutoff frequency for all four MULTIPLIER ranges. This step tests the coupling capacitors and the relays which select them. If the problem cannot be isolated by these steps, it must be in the input circuit or operational amplifiers. The gain values for each amplifier stage given on the simplified filter schematic can be used to further isolate the problem.

DIGITAL CONTROL CIRCUITS. Lines on the scanner and filter card schematics which are labeled as signals (e.g., REMOTE, LOAD, 8, etc.) are high (+5V) whenever that condition is true (operating). Signal lines whose labels include a negation symbol (e.g., $\overline{\text{COMMON}}$, $\overline{\text{REMOTE}}$, $\overline{8}$, $\overline{4}$, $\overline{2}$, $\overline{1}$, etc.) are low (ground) whenever that condition is true (operating). A check for the proper logic levels will typically isolate the problem to a particular component. If a problem appears to exist in more than one area, look for a component common to the problem areas.

4-3. REPAIR.

Repair of System 816 is accomplished using standard printed-circuit repair techniques. Circuit connections are made on both sides of the printed-circuit boards. Therefore, after a component is removed, check for continuity between the circuits on each side of the printed-circuit board. A small "Z" wire may be required if continuity is lost through the hole, and the component to be replaced obscures the lead on the top side of the board.

WARNING

Disconnect the Power cord from the instrument
before removing the scanner assembly.

To remove the front-panel scanner assembly, remove the top cover. Remove the two screws which secure the rail over the scanner assembly and remove the rail. Unplug the two power lines which connect to the back of the scanner assembly on the right-hand side (as viewed from the front). Grasp the front panel firmly, and pull the assembly straight up and out of the mainframe. When replacing the scanner assembly be certain to align the printed-circuit contacts with the sockets on the motherboard, and push the assembly firmly and straight into place. Reconnect the two power lines to the assembly.

4-4. CALIBRATION.

System 816 contains three user-servicable adjustments. Ordinarily these will require adjustment only if certain components are replaced. The following paragraphs describe the checking and setting of each adjustment. Potentiometers R4 and R41 on the filter card require readjustment only if R3, R5, R40, or R42 are replaced. Capacitor C20 on the filter card requires readjustment only if C21 is replaced. These are factory-only adjustments, and should not be attempted by the user.

> NOTE
>
> The completion of the calibration procedure returns the instrument to correct alignment.
>
> **CALIBRATION LIMITS AND TOLERANCES ARE NOT INSTRUMENT SPECIFICATIONS**
>
> Instrument specifications are given in Section 1 of this manual.

POWER SUPPLY ADJUSTMENT. Turn the POWER switch on and check the voltage on the +24 volt bus (pin 2 of XA2B-XA17B). Adjust R1 on the motherboard for a reading of +24 volts (+1, -0).

DC OFFSET ADJUSTMENTS. Potentiometers R7 and R43 (Butterworth only) on the filter cards may require readjustment if the operational amplifiers AR1 or AR5 are replaced.

For Butterworth cards, turn the POWER Switch off and connect the four pairs of jumpers on the left side of the filter card for high-pass operation. Turn the POWER Switch on, and set the front-panel controls to COMMON, NORMAL, and LOCAL. Set a UNITS value of "2" and the highest MULTIPLIER range. Connect an oscilloscope probe to the output pin at the rear-panel connector, and set the oscilloscope controls for DC coupling and vertical sensitivity of 0.01 volts/division. Adjust R43 for zero DC offset. Turn the

POWER Switch off, and reconnect all jumpers for low-pass operation. Turn POWER Switch on and adjust R7 for zero DC offset.

For Bessel cards, turn the POWER Switch on, and set the front-panel controls to COMMON, NORMAL, and LOCAL. Set a UNITS value of "2" and the highest MULTIPLIER range. Monitor the output and adjust R7 for zero DC offset.

SECTION V

PARTS AND SCHEMATICS

5-1. DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

5-2. ERRATA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, errata pages are prepared to summarize the changes made and are inserted inside the shipping carton with this manual. If no such pages exist, the manual is correct as printed.

5-3. ORDERING PARTS

When ordering spare parts, please specify part number, next higher assembly, and serial number of the instrument.

NOTE

The number etched into a PC board is the bare board part number. The assembly (board and components on the board) part number is stamped on the board. The assembly drawing number is not necessarily the assembly number. However, the assembly number and the parts list number are always the same.

DRAWING	DRAWING NUMBER
Model 816 Top Dwg and Parts List	02-000-0800
Mainframe Assembly and Parts List	02-002-0800
Mainboard Schematic	03-004-0820
Mainboard Assembly	004.0820
Mainboard Parts List	004.0820
Side Plate Assembly	02-002-0860
Side Plate Parts List	002.0860
Card Cage Assembly	02-002-0890
Card Cage Assembly Parts List	002.0890
Scanner Schematic	03-004-0810
Scanner PCA Assembly	02-004-0810
Scanner PCA Parts List	004.0810
Front Panel Assembly and Parts List	02-001-0800
Side Frame Assembly and Parts List	02-002-0867
Rear Panel Assembly	02-002-0875
Rear Panel Parts List	002.0875
Shield Plate Assembly and Parts List	02-002-0870
Butterworth Filter Schematic (10 Hz-150 kHz)	03-004-0830
Butterworth Filter PCB Assembly	02-004-0830
Butterworth Filter Parts List	004-0830
Bessel Filter Schematic (10 Hz-150 kHz)	03-004-0835
Bessel Filter PCB Assembly	02-004-0835
Bessel Filter Parts List	004-0835
Butterworth Filter Schematic (1 Hz-15 kHz)	03-004-0840
Butterworth Filter PCB Assembly	02-004-0840
Butterworth Filter Parts List	004-0840
Bessel Filter Schematic (1 Hz-15 kHz)	03-004-0845
Bessel Filter PCB Assembly	02-004-0845
Bessel Filter Parts List	004-0845
Butterworth Filter Schematic (.1 Hz-1.5 kHz)	03-004-0850
Butterworth Filter PCB Assembly	02-004-0850
Butterworth Filter Parts List	004-0850
Bessel Filter Schematic (.1 Hz-1.5 kHz)	03-004-0855
Bessel Filter PCB Assembly	02-004-0855
Bessel Filter Parts List	004-0855
Strain Relief Kit Parts List	002.0899

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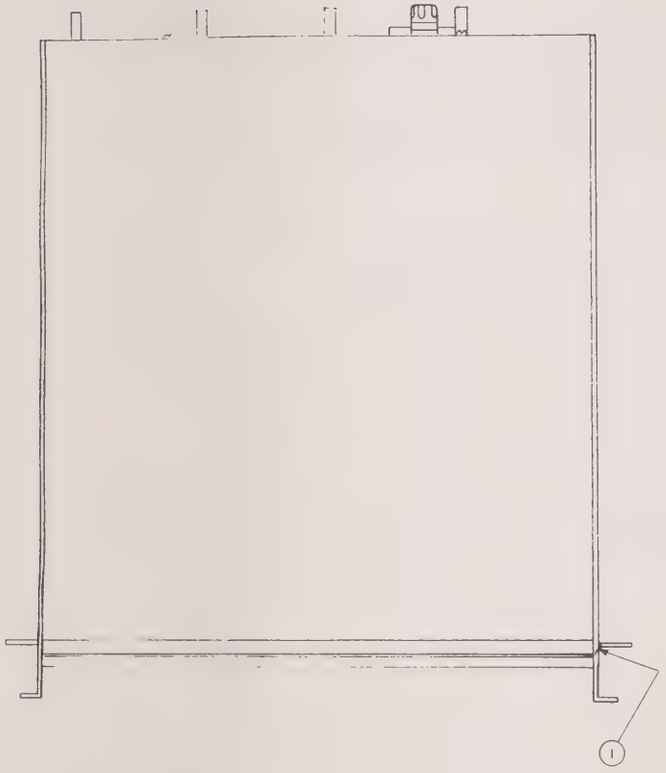

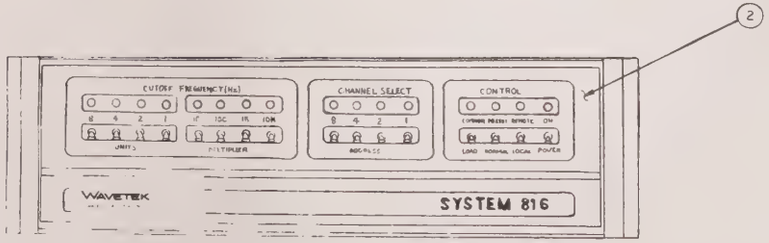

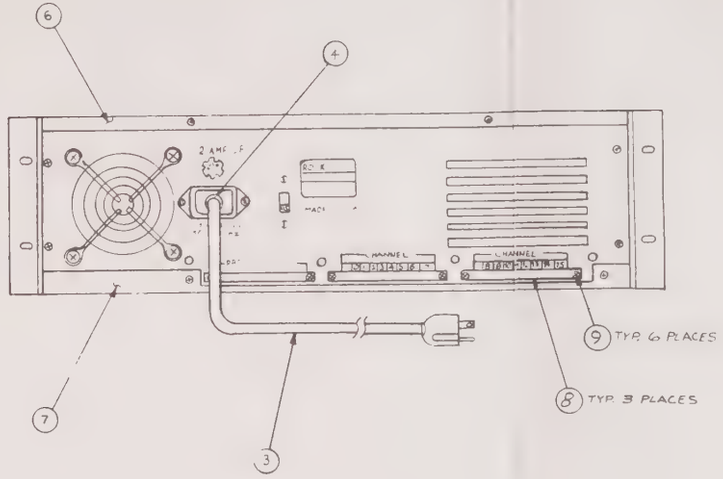

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NONE	STRAIN RELIEF KIT 816			002 0899	1
NONE	COVER: TOP, BLACK	MPV40464-26	BURLEY	304 0105	1
NONE	COVER: BOTTOM, 816, BLACK	MPV40431	BURLEY	304 0207	1
NONE	CONN: PC .156 18POS DR EYE	50-36A-30	CINCH	350 3601	3
NONE	M SCR: ST ZN 4-40 X 3/8 PH			381 4062	6
NONE	PWR CORD	17251	BELDN	6001-80-0005	1
NONE	INST MANUAL: 816			800 0080	1 5

WAVETEK PARTS LIST	TITLE: 816-GEN MAINFRAME	ASSEMBLY NO.: 000 0816	REV
		PAGE 1	

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ENG APPVL		
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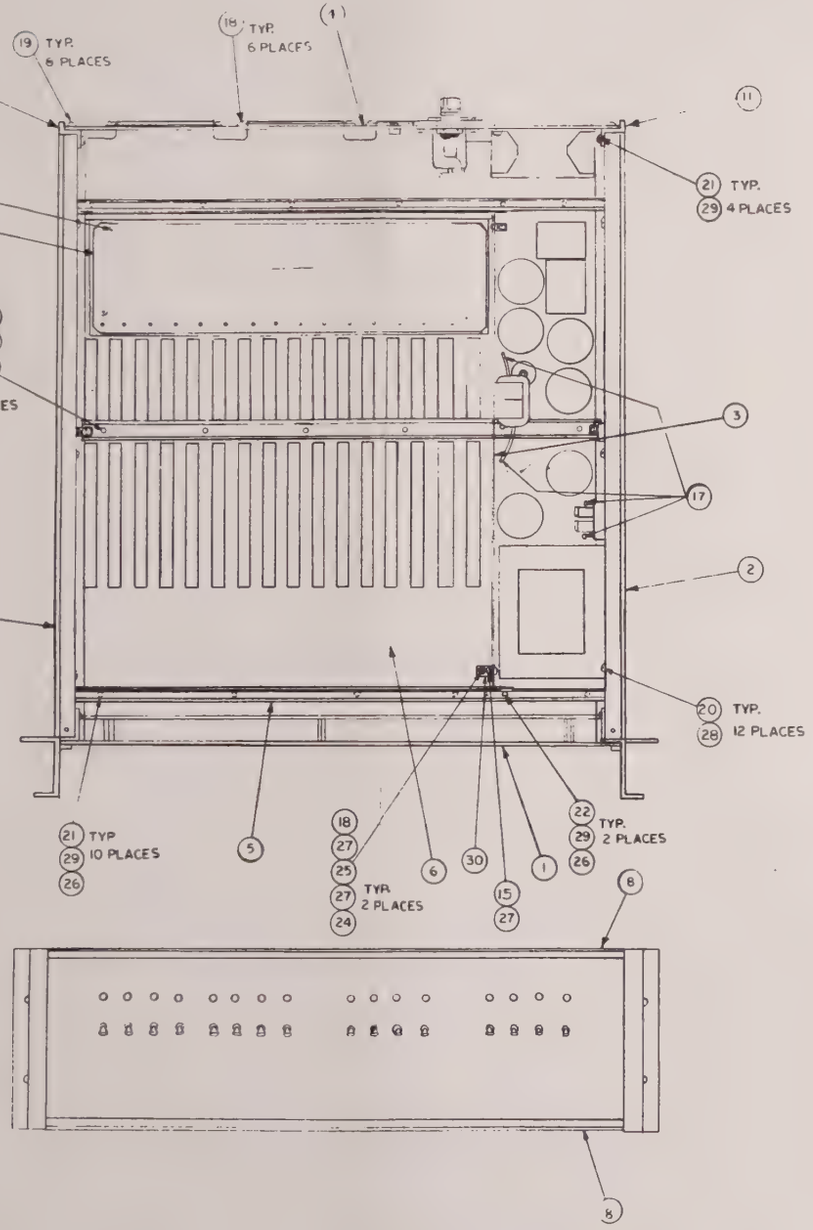

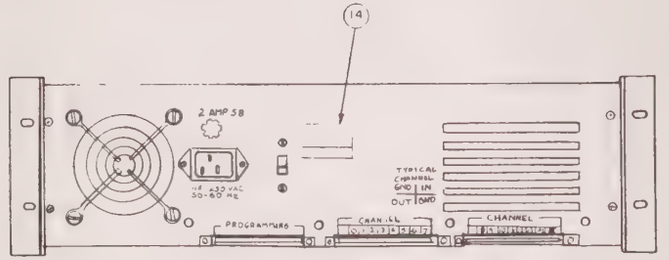

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NONE	SHIELD PLATE ASSY 816			002.0870	1
NONE	REAR PANEL ASSY 816			002.0875	1
NONE	CARD CAGE ASSY 816			002.0890	1
NONE	MAINBOARD ASSY 816			004.0820	1
NONE	TRIM: REAR	MP40281-2	BUKEY	304.0902	2
NONE	TRIM: FRONT TOP SUPR/SNUB 512	MP40318-4	BUKEY	307.0914	2
NONE	PC: SHIELD (816MB)			320.0850	1
NONE	SOCKET: INSULATED	430-3378-01-03-10	CAMBN	353.0105	2
NONE	CONN: TERM PIN .025 WW (NAIL)	WPB-025-360-GH-GOLD	A/B	354.0003	9
NONE	SLVNG: PLASTIC FBRGLS #18AWG			378.5181	7
NONE	M SCR: ST ZN PH 4-40 X 1/4 PH			381.4042	1
NONE	M SCR: ST ZN 4-40 X 3/8 PH			381.4062	2
NONE	M SCR: ST ZN PHIL 6-32X1/4			381.6042	8
NONE	M SCR: ST ZN PH 6-32X3/8 PH			381.6062	12
NONE	M SCR: ST ZN PH 8-32X3/8 PH			381.8062	16
NONE	M SCR: ST ZN PH 8-32X1/2 PH			381.8082	6
NONE	NUT: HX ST ZN 4-40X1/4 AF			387.4080	2
NONE	WASHER: FLAT STL ZN #4			388.0040	2
NONE	WASHER: FLAT STL #8 .172ID 3/8OD .032THK			388.0080	18
NONE	WASHER: EXT LK STL ZN #4			388.1041	9
NONE	WASHER: EXT LK STL ZN #6			388.1061	12
NONE	WASHER: EXT LK STL ZN #8			388.1081	22
NONE	BKT: ANG ST ZN 1/2X1/2			389.3002	1

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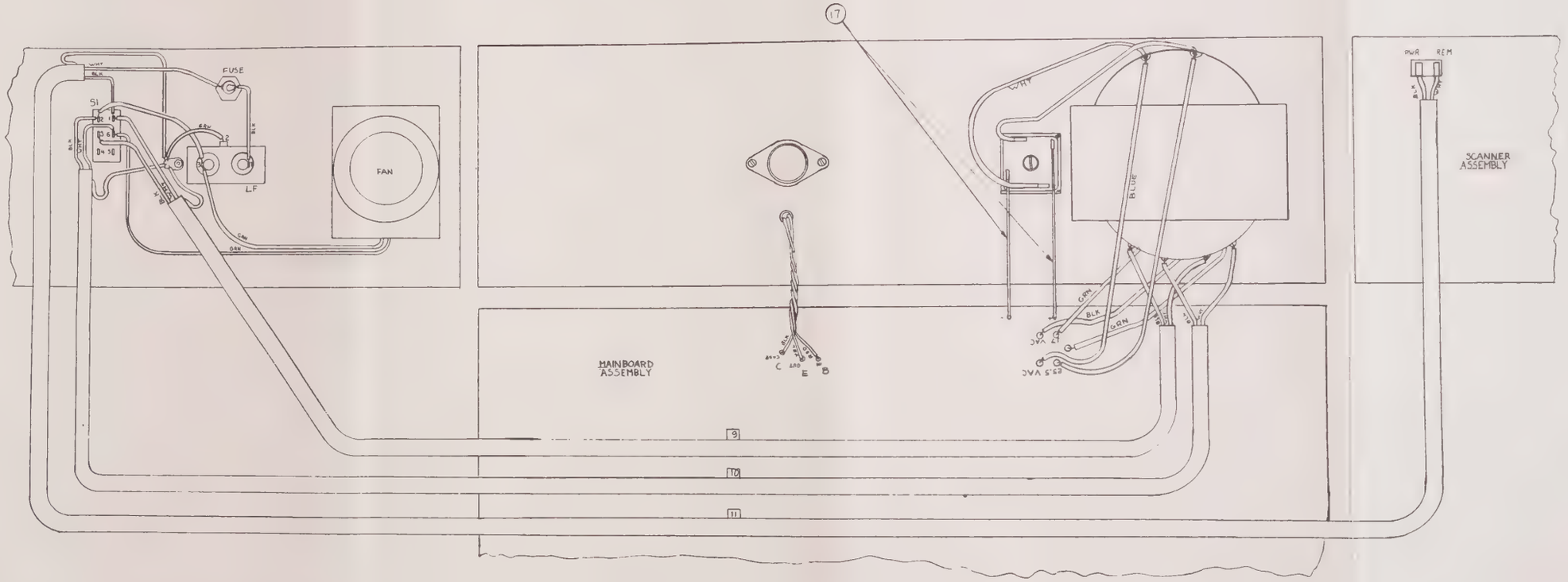

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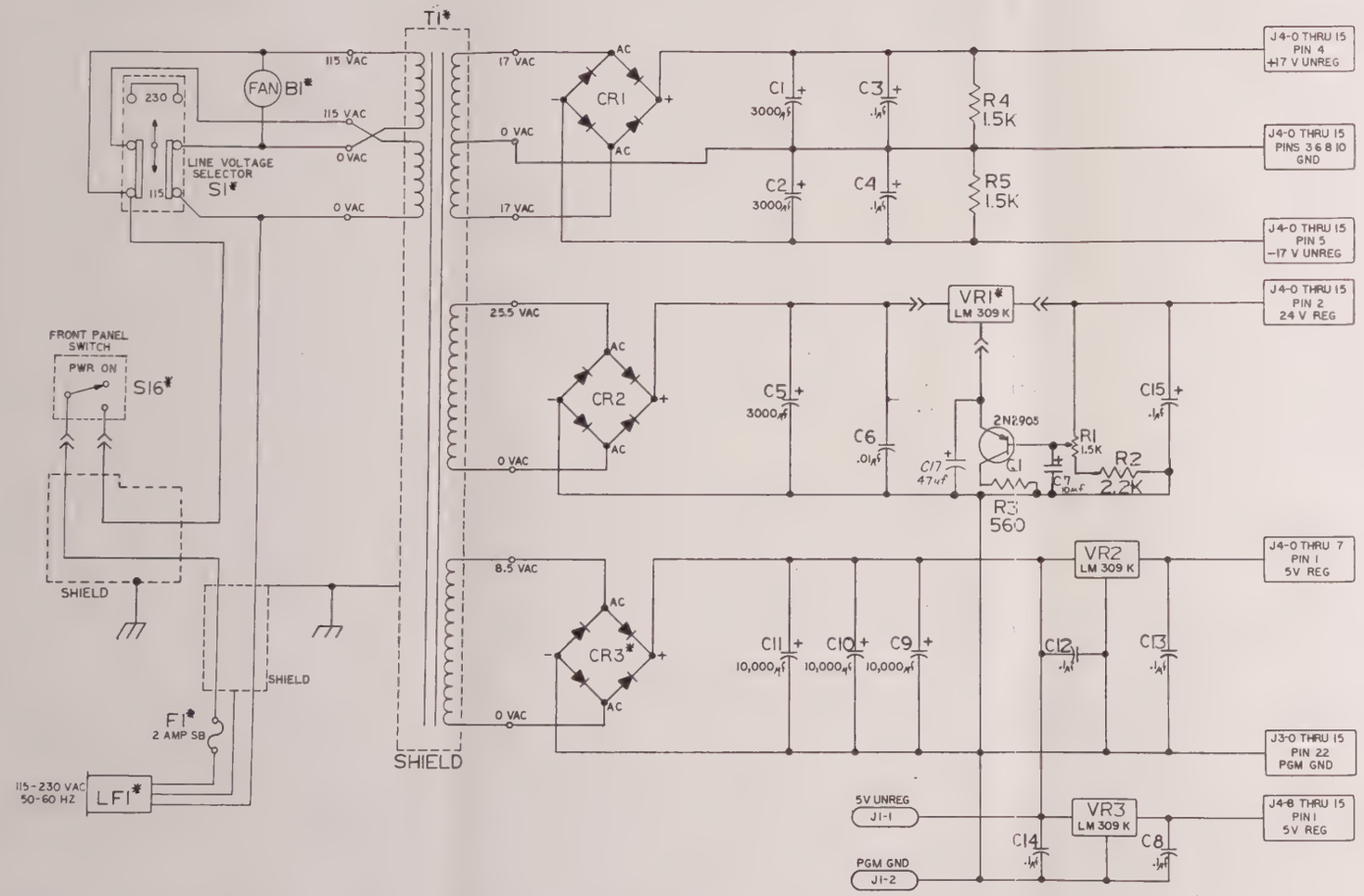

LOAD 0	J1-7	J3-0-4
1	J1-8	J3-1-4
2	J1-9	J3-2-4
3	J1-10	J3-3-4
4	J1-11	J3-4-4
5	J1-12	J3-5-4
6	J1-13	J3-6-4
7	J1-14	J3-7-4
8	J1-15	J3-8-4
9	J1-16	J3-9-4
10	J1-17	J3-10-4
11	J1-18	J3-11-4
12	J1-19	J3-12-4
13	J1-20	J3-13-4
14	J1-21	J3-14-4
LOAD 15	J1-22	J3-15-4

READ 0	J1-H	J3-0-3
1	J1-J	J3-1-3
2	J1-K	J3-2-3
3	J1-L	J3-3-3
4	J1-M	J3-4-3
5	J1-N	J3-5-3
6	J1-P	J3-6-3
7	J1-R	J3-7-3
8	J1-S	J3-8-3
9	J1-T	J3-9-3
10	J1-U	J3-10-3
11	J1-V	J3-11-3
12	J1-W	J3-12-3
13	J1-X	J3-13-3
14	J1-Y	J3-14-3
READ 15	J1-Z	J3-15-3

MLT 10DI	J2-M	J3-0....15-12
MLT 100 DI	J2-N	J3-0....15-11
MLT 1K DI	J2-P	J3-0....15-13
MLT 10K DI	J2-R	J3-0....15-10
FRQ 1DI	J2-11	J3-0....15-16
FRQ 2DI	J2-12	J3-0....15-15
FRQ 4DI	J2-13	J3-0....15-14
FRQ 8DI	J2-14	J3-0....15-17
MLT 1K DO	J2-15	J3-0....15-8
MLT 10K DO	J2-16	J3-0....15-9
MLT 100 DO	J2-17	J3-0....15-7
MLT 10 DO	J2-18	J3-0....15-6
FRQ 8 DO	J2-22	J3-0....15-18
FRQ 4 DO	J2-21	J3-0....15-20
FRQ 2 DO	J2-20	J3-0....15-21
FRQ 1DO	J2-19	J3-0....15-19
PRST DI	J2-B	J3-0....15-5

CHSEL 1	J5-1	J1-C
DEVSEL	J5-2	J1-B
CHSEL 2	J5-3	J1-D
PRESET	J5-4	J1-A
CHSEL 4	J5-5	J1-E
PARPGM	J5-6	J1-5
CHSEL 8	J5-7	J1-F
LOAD	J5-8	J1-6
LDACK	J5-9	J2-A
FRQ 1	J5-10	J2-Y
FRQ 2	J5-11	J2-Z
FRQ 4	J5-12	J2-W
FRQ 8	J5-13	J2-X
MLT 10	J5-14	J2-V
MLT 100	J5-15	J2-U
MLT 1K	J5-16	J2-S
MLT 10 K	J5-17	J2-T

NOTES:
* 1. S1, B1, FL1, AND F1 ARE MOUNTED ON REAR PANEL ASSY, T1, VR1, AND CR3, ARE MOUNTED ON RIGHT SIDE PANEL ASSY. S16 IS MOUNTED ON FRONT PANEL SCANNER ASSY.
2. ALL RESISTOR VALUES ARE IN OHMS.

OUT 0	J4-0-7	J6-C
1	J4-1-7	J6-E
2	J4-2-7	J6-H
3	J4-3-7	J6-K
4	J4-4-7	J6-M
5	J4-5-7	J6-P
6	J4-6-7	J6-S
7	J4-7-7	J6-V
8	J4-8-7	J7-C
9	J4-9-7	J7-E
10	J4-10-7	J7-H
OUT 11	J4-11-7	J7-K

OUT 12	J4-12-7	J7-M
13	J4-13-7	J7-P
14	J4-14-7	J7-S
OUT 15	J4-15-7	J7-U

GND	J4-0-8	J6-D
	J4-1-8	J6-F
	J4-2-8	J6-J
GND	J4-3-8	J6-L

GND	J4-4-8	J6-N
	J4-5-8	J6-R
	J4-6-8	J6-T
	J4-7-8	J6-V
	J4-8-8	J7-D
	J4-9-8	J7-F
	J4-10-8	J7-J
	J4-11-8	J7-L
	J4-12-8	J7-N
	J4-13-8	J7-R
	J4-14-8	J7-T
GND	J4-15-8	J7-V

IN 0	J4-0-9	J6-4
1	J4-1-9	J6-6
2	J4-2-9	J6-8
3	J4-3-9	J6-10
4	J4-4-9	J6-12
5	J4-5-9	J6-14
6	J4-6-9	J6-16
7	J4-7-9	J6-18
8	J4-8-9	J7-4
9	J4-9-9	J7-6
10	J4-10-9	J7-8
IN 11	J4-11-9	J7-10

IN 12	J4-12-9	J7-12
13	J4-13-9	J7-14
14	J4-14-9	J7-16
IN 15	J4-15-9	J7-18

GND	J4-0-10	J6-3
	J4-1-10	J6-5
	J4-2-10	J6-7
GND	J4-3-10	J6-9

GND	J4-4-10	J6-11
	J4-5-10	J6-13
	J4-6-10	J6-15
	J4-7-10	J6-17
	J4-8-10	J7-3
	J4-9-10	J7-5
	J4-10-10	J7-7
	J4-11-10	J7-9
	J4-12 10	J7-11
	J4-13-10	J7-13
	J4-14 10	J7-15
GND	J4-15-10	J7-17

TOLERANCE (EXCEPT AS NOTED)
DECIMAL XXX ±10 XX ±02
FRACTIONAL ± 1/64
ANGULAR ±

WAVETEK

DRAWN 3/13/84
APPROVED BY

TITLE: SCHEMATIC MAINBOARD 816

DATE

DRAWING NUMBER: 0-804 0820

REV: C

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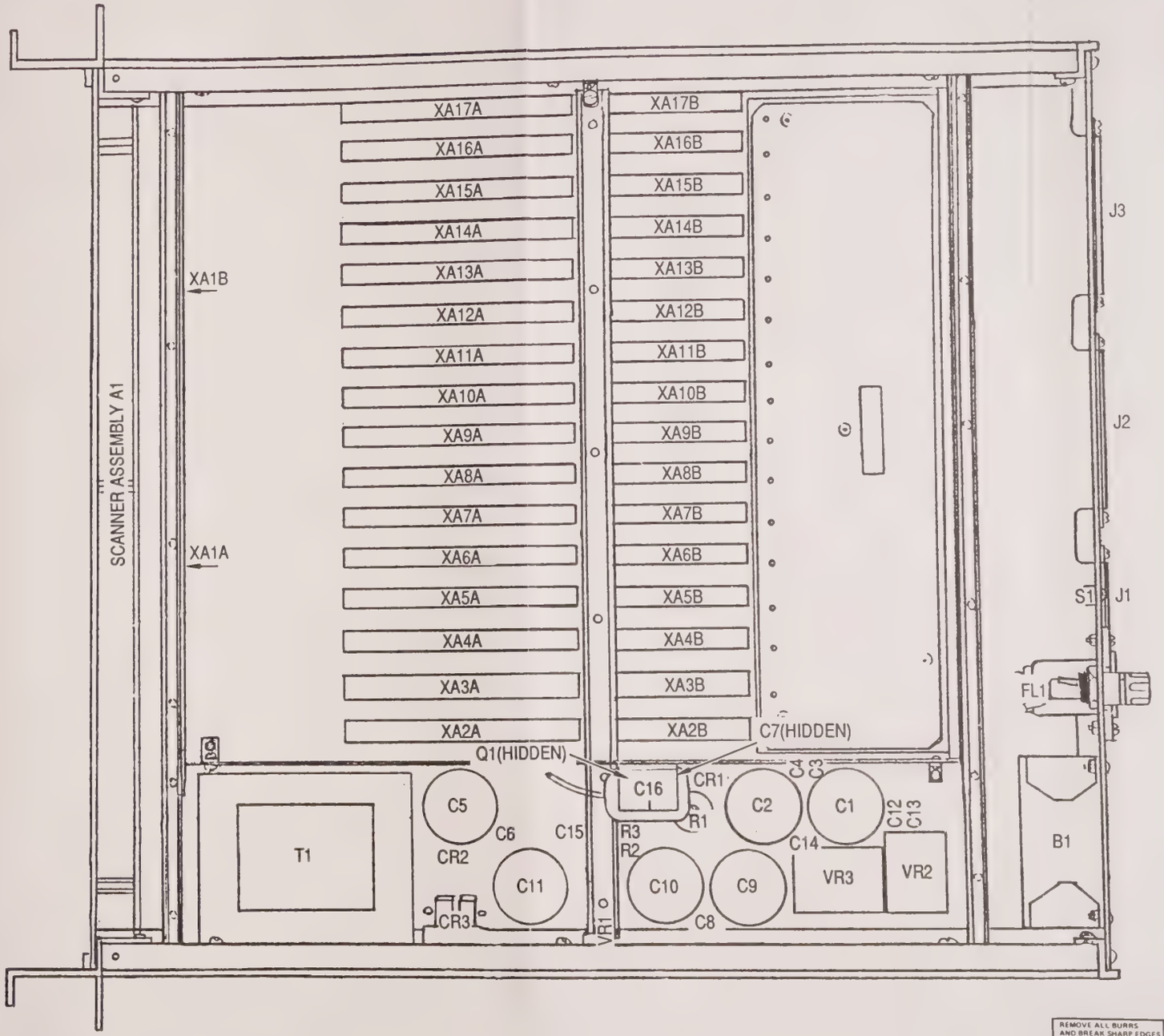

MADE FROM 02-002-0800B

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: MAINFRAME ASSY
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG	MODEL NO: 816	DWG NO: 004 0820 REV
	SCALE	CODE IDENT: 23338	SHEET OF

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C6	CAP,CER, .01UF GMV 1KV	DD-103	CRL	100.3100	1
C12 C13 C14 C8	CAP,CER, .1UF +80 -20% 16V	XXUK16-104	CRL	100.4101	4
C15 C3 C4	CAP,TANT, .10UF 20% 35V	T368A104M035A*	KEMET	109.4100	3
C7	CAP,TANT, 10UF 20% 20V	T368B106M025A*	KEMET	109.6100	1
C17	CAP,ELECT, 47UF 20% 63V	47/63-81009	SIEM	109.6470	1
C1 C2 C5	CAP,ELECT, 3000UF 50V (PC)	3487AE332M050KM	MEPCO	109.8300	3
C10 C11 C9	CAP,ELECT, 10000UF 15V (PC)	3487BD103M016KM	MEPCO	109.9100	3
R3	RES,COMP 560 OHM 5% 1/2W			116.1562	1
R4 R5	RES,COMP 1.5K OHM 5% 1/2W			116.2152	2
R2	RES,CFLM 2.2K OHM 5% 1/4W			116.2221	1
R1	RES, VAR WW 1.5K 3/4" RND PC	B091626	CTS	118.2154	1

WAVETEK PARTS LIST	TITLE: MAINBOARD ASSY 816	ASSEMBLY NO. 004.0820	REV K

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	M SCR: ST ZN PH 4-40 X 1/2 PH			381.4082	4
NONE	NUT: HX ST ZN 4-40X1/4 AF			387.4080	7
NONE	WASHER: FLAT STL ZN #4			388.0040	3
NONE	WASHER: INT LK STL ZN #4			388.1040	11

WAVETEK PARTS LIST	TITLE: MAINBOARD ASSY 816	ASSEMBLY NO. 004.0820	REV K

PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
VR2 VR3	Q: P.V. REG 5V 5% 1A TO-3	LM309K-STEEL	NSC	120.0051	2
NONE	ASSY, PC BD PREPPED 816-0820	816-2684	WVTK	1208-00-2684	1
CR1	SIL FWB 50PIV 1.5A	PF-05	EDI	130.0140	1
CR2	SIL FWB 100PIV 5A			130.1440	1
Q1	Q: SIL PNP (2N2905A)	2N2905	MOT	136.2905	1
NONE	SPACER: SWITCH NYLON 1/16"	FW4-062	MICRO	349.2010	3
NONE	CONN: PC .156 10POS SR ST	50-108-10	CINCH	350.1002	16
NONE	CONN: PC .156 22POS SR ST	50-228-10	CINCH	350.2202	16
J1 J2	CONN: PC .156 22POS DR ST	50-448-10	CINCH	350.4401	2
NONE	HEAT SINK: TO-3 U .234H	6104B	THERM	367.0403	2
NONE	SPACER: TXSTR LEAD, NYL, LOW	10414	MILRO	376.2108	1
NONE	M SCR: ST ZN 4-40 X 3/8 PH			381.4062	3

WAVETEK PARTS LIST	TITLE: MAINBOARD ASSY 816	ASSEMBLY NO. 004.0820	REV K

PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST MAINBOARD ASSEMBLY
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.030 ANGLES ±1		
	DO NOT SCALE DWG		MODEL NO: 816
	SCALE		DWG NO: 004.0820 REV: K
			CODE IDENT: 23338 SHEET 1 OF 1

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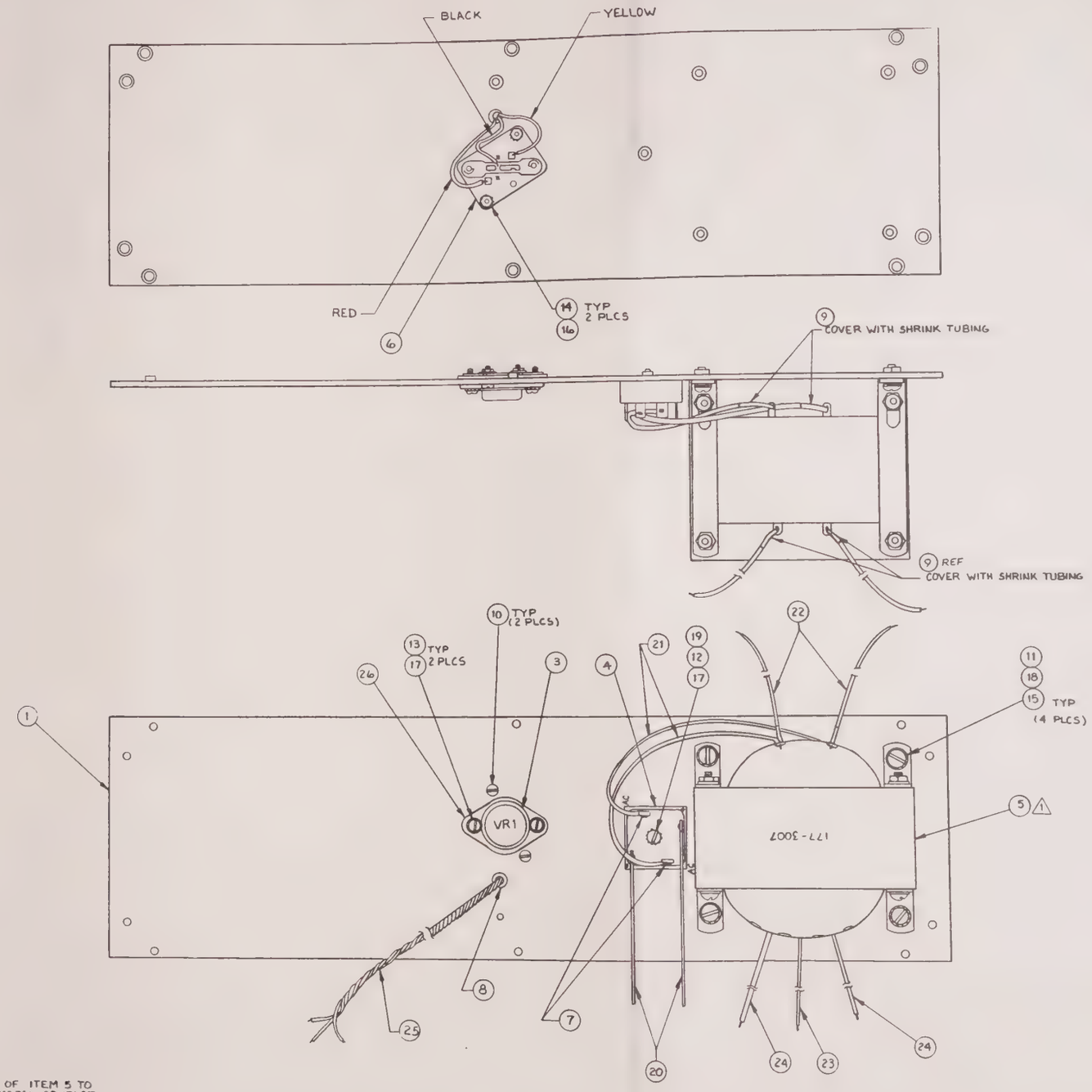
REV	ECO	BY	DATE	APP
A	6011	WNT	10-11-76	KUN
B	7872	SD	11-11-86	REG
C	7985	WC	3-10-87	REG
D	7991	WC	6/8/12	RMG



⚠1 FILE (AS REQUIRED) 4 LEGS OF ITEM 5 TO INSURE GOOD METAL-TO-METAL CONTACT.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN W.L. Caldwell	DATE 5 26 87	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED		TITLE: SIDE PLATE ASSEMBLY
FINISH WAVETEK PROCESS	PROJ ENGR		
	RELEASE APPROV R.B. Grimm	6/3/13	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS 1/64 DECIMALS .XX ± .03 .XXX ± .010 ANGLES ± 1°		SIZE D · FSCM NO 23338 · DWG NO 02-7007-0540 · REV D · SCALE FULL · MODEL 516

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
4	SIL FWB 50PIV 12A			130.0341	1
5	XFMR: PWR DUAL PRI	177.3007	WVTK	177.3007	1
1	SIDE PLATE: RIGHT 816			304.0909	1
6	SOCKET: I.C. TO-3	4610	KEYST	353.0301	1
7	LUG: CRIMP FEM SNAP DTSCDM	814-2M0A	T&B	359.0003	2
8	SNAP BUSHING: 1/4" PLASTIC BLK			367.1103	1
26	INSULATOR: MICA TO-3	4662	KEYST	368.3003	1
20	WIRE: BUSS TINNED 818 AWG	W1818	MEICO	378.0400	10
21	WIRE: 814 AWG STR WHITE	3214/19	MEICO	378.1294	14
22	WIRE: 818 AWG STR BLUE	1118/19	MEICO	378.1464	16
23	WIRE: 824 AWG BON BLACK	1524	MEICO	378.1705	6
24	WIRE: 824 AWG BON GREEN	1524	MEICO	378.1755	12
25	CABLE: TW 3 COND RED/YEL/BLK	3134	ALPHA	378.4004	7

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	SIDE PLATE ASSY 816	002.0860	D

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
VR1	VOLT REGULATOR, 3 A.5V+	LM323K	NSC	7000-03-2300	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	SIDE PLATE ASSY 816	002.0860	D

PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
26	SHRINK TBG PLYFIN BLACK 1/4"			378.3540	4
10	M XCR: ST ZN SL 4-40X3/8 PH			380.4062	2
11	M SCR: ST ZN SL 8-32X3/8 PH			380.8062	4
NONE	M SCR: ST ZN 6-32X3/4 PH			381.6122	1
13	M SCR: ST ZN SL 6X1/2 PHIL TYPE BPN			386.6080	2
14	NUT: HX ST ZN 4-40X1/4 AF			387.4080	2
19	WASHER: FLAT STL #6 .147ID .312OD .028THK			388.0060	1
15	WASHER: FLAT STL #8 .172ID 3/8OD .032THK			388.0080	4
16	WASHER: EXT LK STL ZN #4			388.1041	2
17	WASHER: EXT LK STL ZN #6			388.1061	3
18	WASHER: EXT LK STL ZN #8			388.1081	4

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	SIDE PLATE ASSY 816	002.0860	D

PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE
MATERIAL	PROJ ENGR	
	RELEASE APPROV	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030	
	DO NOT SCALE DWG	
	SCALE	

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
PARTS LIST
SIDE PLATE ASSEMBLY

MODEL NO	DWG NO	REV
816	002.0860	D

CODE IDENT	SHEET
23338	1 OF 1

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A7986

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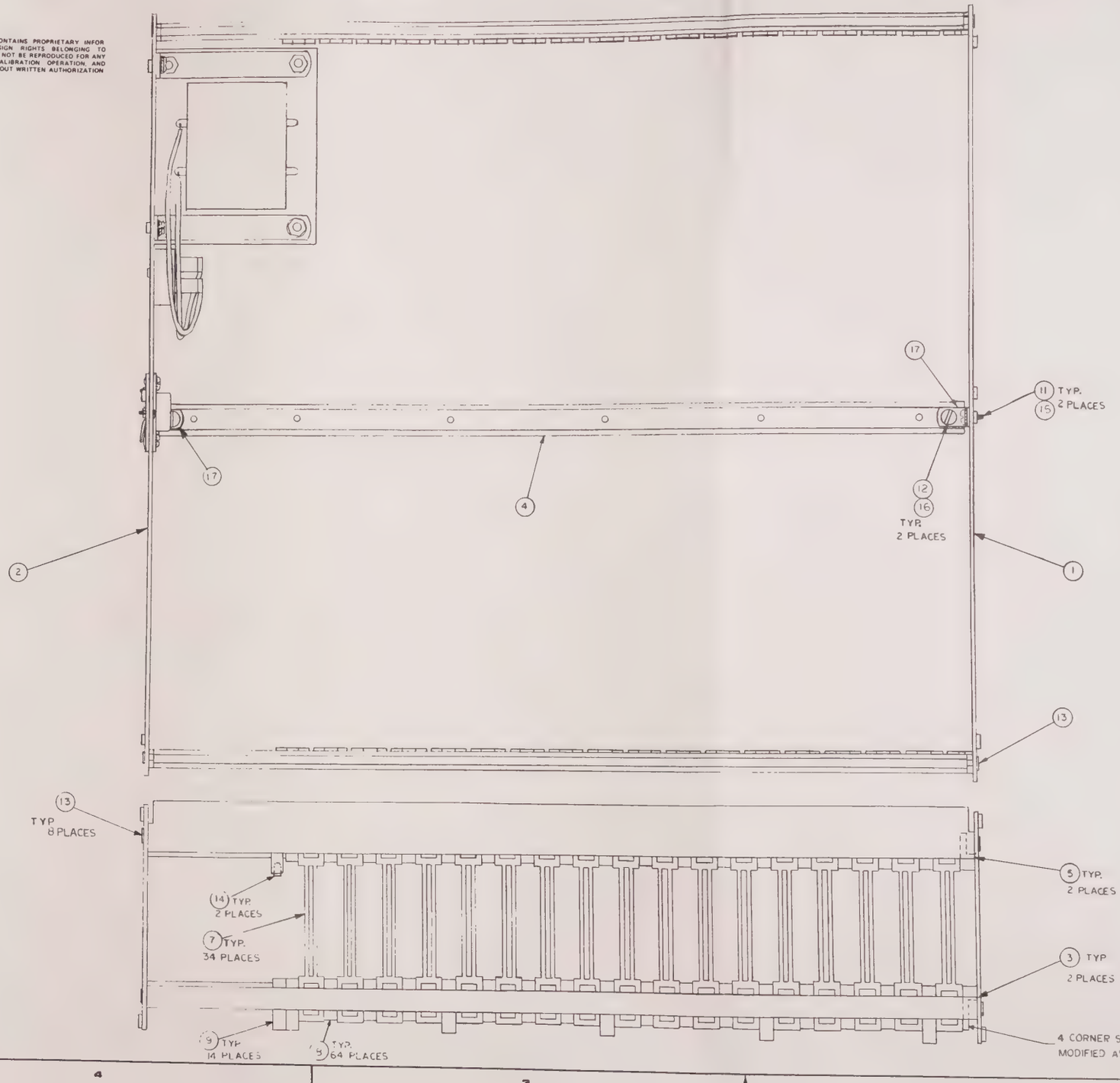

		DATE
DRAWN BY	W. N. T.	
CHECKED BY:		
ENG APPVL.	[illegible]	11/12
MFG APPVL.	[illegible]	11/12

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE
.XXX ±
.XX ±
X/x ± 1/64
∠° ± 1°

WAVETEK

TITLE
CARD CAGE ASSEMBLY
816

SIZE	DRAWING NO.	REV
D	02 002 [illegible]	A

SCALE 1:1

DO NOT SCALE DRAWING

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SIDE PLATE ASSY 816			002.0860	1
NONE	EXT CARD GUIDE 816	41222	SCANB	002.0880	2
NONE	EXT MAINBOARD SUPPORT 816	41221	SCANB	002.0885	1
NONE	EXT CARD GUIDE MT TOP 816	03.002.0895	SCANB	002.0895	2
NONE	SIDE PLATE: LEFT 816			304.0908	1
NONE	CARD GUIDE: NYLON, WHT (816)	T-309-39	SCANB	362.0611	34
NONE	SPACER: CARD GUIDE .250 (816)	T-101-250	SCANB	362.0612	64
NONE	SPACER STOP: CARD GUIDE	T-910	SCANB	362.0613	14
NONE	M SCR: ST ZN SL 6-32X3/8 PH			380.6061	2
NONE	M SCR: ST ZN SL 8-32X3/8 PH			380.8062	2
NONE	SKT ST SCR ST8-32X1/4 BLK OX HEX SO SET, CP PT			386.8040	2
NONE	SKT CSCR: BLK 8-32X1/2 82FH			386.8081	8

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	CARD CAGE ASSY 816	002 0890	A
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	WASHER: EXT LK STL ZN #6			388.1061	2
NONE	WASHER EXT LK STL ZN [redacted]			388.1081	2
NONE	BKT: ANG ST ZN .628 X [redacted]	618	KEYST	389.3004	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	CARD CAGE ASSY 816	002.0890	A
		PAGE 2	

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJENGR		TITLE: PARTS LIST CARD CAGE ASSEMBLY
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		MODEL NO. 816 / DWG NO. 002.0890 / REV A
	DO NOT SCALE DWG		CODE IDENT 23338 / SHEET 1 OF 1
	SCALE		

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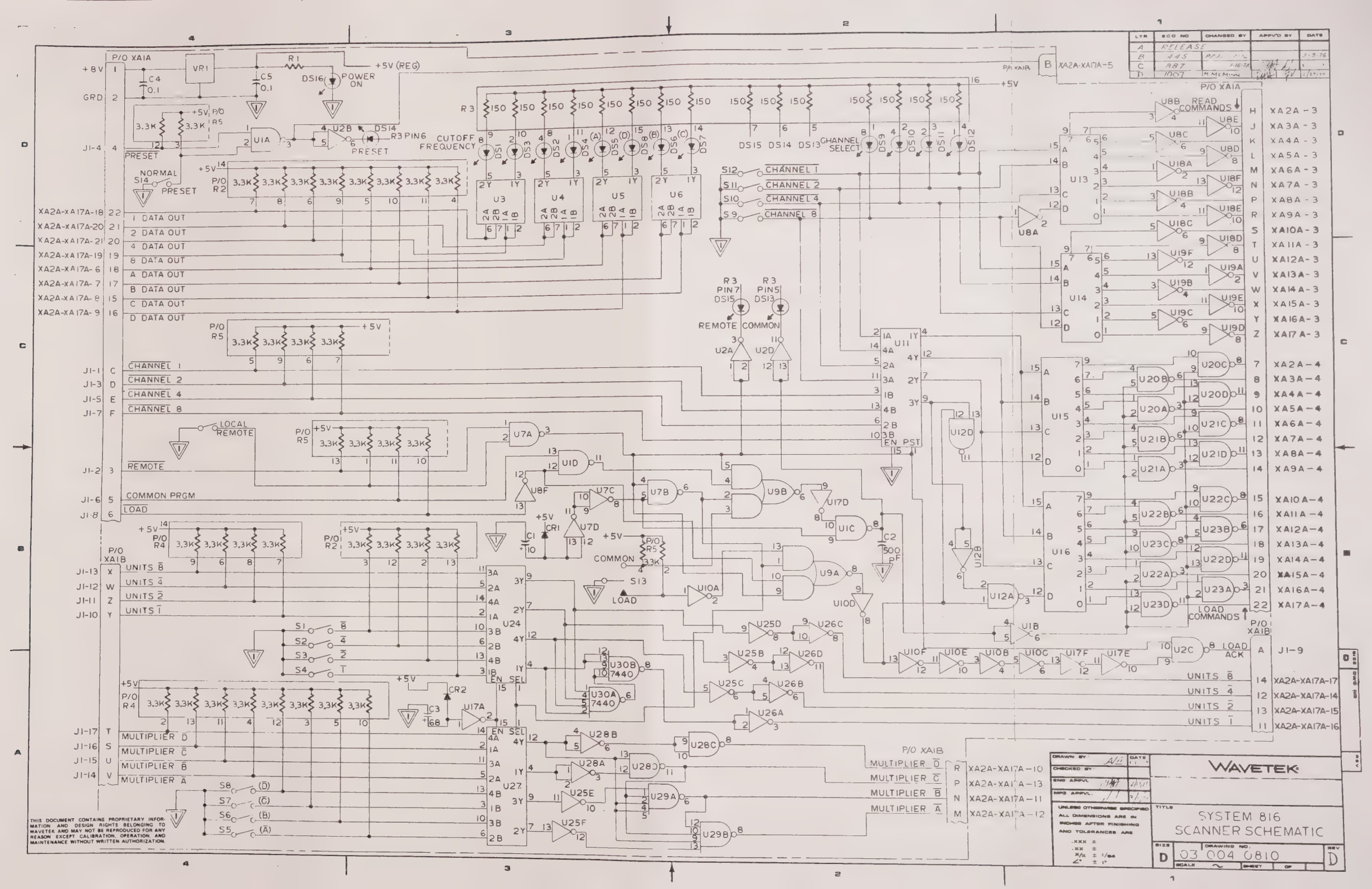
P/O XA1A
+8V
GRD
J1-4
VR1
C4 0.1
C5 0.1
R1
+5V (REG)
DS16 POWER ON
U1A
U2B
DS14
R3 PIN6
PRESET
NORMAL
S14
PRESET
R3 150 150 150 150 150 150 150 150
CUTOFF FREQUENCY
DS1 DS3 DS2 DS4 (A) DS5 (D) DS8 (B) DS6 (C) DS7
DS15 DS14 DS13
CHANNEL SELECT
DS9 DS10 DS11 DS12
S12 CHANNEL 1
S11 CHANNEL 2
S10 CHANNEL 4
S9 CHANNEL 8
U3 U4 U5 U6
P/O R2
P/O R5
P/O R4
P/O R3
XA2A-XA17A-18 1 DATA OUT
XA2A-XA17A-20 2 DATA OUT
XA2A-XA17A-21 4 DATA OUT
XA2A-XA17A-19 8 DATA OUT
XA2A-XA17A-6 A DATA OUT
XA2A-XA17A-7 B DATA OUT
XA2A-XA17A-8 C DATA OUT
XA2A-XA17A-9 D DATA OUT
R3 PIN7 DS15 REMOTE
R3 PIN5 DS13 COMMON
U2A U2D
U11
J1-1 C CHANNEL 1
J1-3 D CHANNEL 2
J1-5 E CHANNEL 4
J1-7 F CHANNEL 8
LOCAL REMOTE
J1-2 3 REMOTE
J1-6 5 COMMON PRGM
J1-8 6 LOAD
U7A U10 U8F U7C U7B U9B U17D U1C U7D CR1 C1 10
U9A U10A U10D
S13 LOAD
COMMON
C2 500 pF
U12D U12B U12A U1B
U13 U14 U15 U16
U8A U8B READ COMMANDS U8E U8C U8D U18A U18F U18B U18E U18C U18D U19F U19A U19B U19E U19C U19D
U20C U20B U20D U20A U21C U21B U21D U21A U22C U22B U23B U23C U22D U22A U23A U23D
LOAD COMMANDS
H XA2A-3
J XA3A-3
K XA4A-3
L XA5A-3
M XA6A-3
N XA7A-3
P XA8A-3
R XA9A-3
S XA10A-3
T XA11A-3
U XA12A-3
V XA13A-3
W XA14A-3
X XA15A-3
Y XA16A-3
Z XA17A-3
7 XA2A-4
8 XA3A-4
9 XA4A-4
10 XA5A-4
11 XA6A-4
12 XA7A-4
13 XA8A-4
14 XA9A-4
15 XA10A-4
16 XA11A-4
17 XA12A-4
18 XA13A-4
19 XA14A-4
20 XA15A-4
21 XA16A-4
22 XA17A-4
P/O XA1B
J1-13 X UNITS 8
J1-12 W UNITS 4
J1-11 Z UNITS 2
J1-10 Y UNITS 1
S1 8
S2 4
S3 2
S4 1
U24 U30B 7440 U30A 7440
U25D U26C U25B U26D U25C U26B U26A
U10F U10E U10B U10C U17F U17E
U2C LOAD ACK
A J1-9
UNITS 8 14 XA2A-XA17A-17
UNITS 4 12 XA2A-XA17A-14
UNITS 2 13 XA2A-XA17A-15
UNITS 1 11 XA2A-XA17A-16
J1-17 T MULTIPLIER D
J1-16 S MULTIPLIER C
J1-15 U MULTIPLIER B
J1-14 V MULTIPLIER A
CR2 C3 68 U17A
U27
U28B U28C U28A U28D U25E U29A U25F U29B
S8 (D) S7 (C) S6 (B) S5 (A)
P/O XA1B
MULTIPLIER D R XA2A-XA17A-10
MULTIPLIER C P XA2A-XA17A-13
MULTIPLIER B N XA2A-XA17A-11
MULTIPLIER A M XA2A-XA17A-12
P/O XA1A B XA2A-XA17A-5
+5V
LTR ECO NO CHANGED BY APPV'D BY DATE
A RELEASE
B 445 PAL 7-9-76
C 887 7-16-76
D 1007 M McMINN 7-27-76
DRAWN BY
CHECKED BY
ENG APPVL.
MFG APPVL.
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE .XXX ± .XX ± X/X ± 1/64 ∠° ± 1°
WAVETEK
TITLE
SYSTEM 816
SCANNER SCHEMATIC
SIZE D
DRAWING NO. 03 004 0810
REV D
SCALE
SHEET OF
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LTR	ECO NO	CHANGED BY	APPVD BY	DATE
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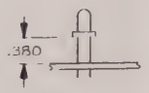

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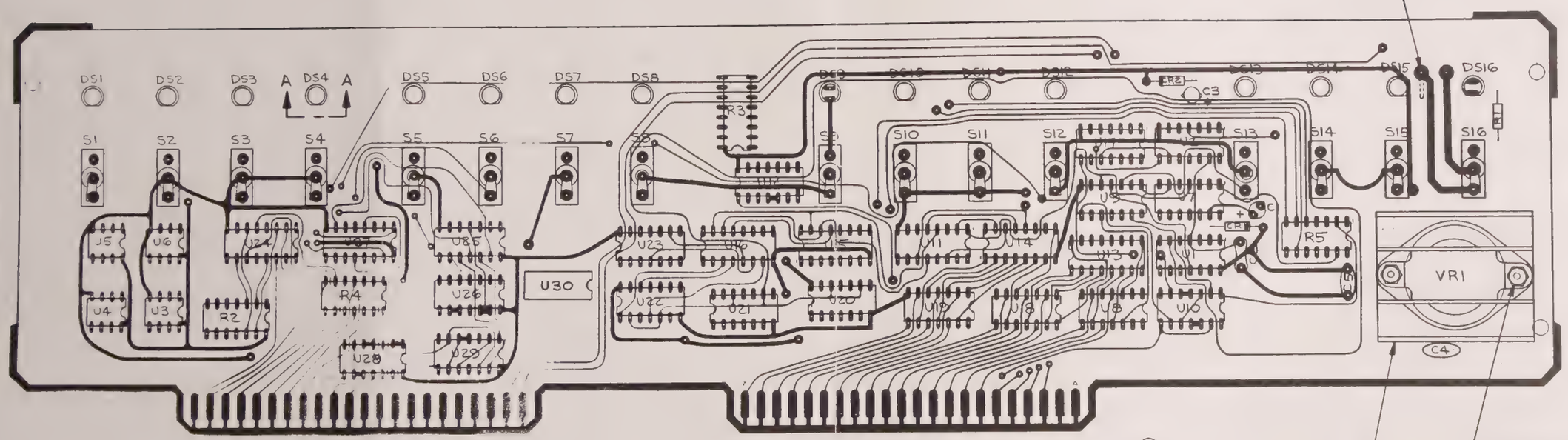
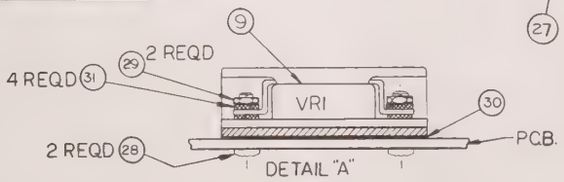


(26) INSTALL FROM SOLDER SIDE OF BOARD

(27)

SEE DETAIL "A"



NOTE :

1. FOR ARTWORK LOWER THAN REV C OMIT U30.

SEE SEPARATE PARTS LIST

DRAWN BY Paul	2/26/88	WAVETEK SAN DIEGO, CALIFORNIA
CHECKED BY		
ENG APPVL	2/26	Confidential property of WAVETEK CORP. not to be disclosed to others, reproduced or used for any purpose except as authorized in writing by above.
MFG APPVL	2/26	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE .XXX ± .XX ± X/X ± 1/64 ∠° ± 1°		TITLE ASSEMBLY SCANNER - 816
		SIZE D DRAWING NO 02 004-0810 REV G
		SCALE 2:1 SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C4 C5	CAP, MOND, 0.1UF 50V Z5U	SR215E104ZAT	AVX	100 4102	2
C2	CAP MICA FX VAL DIP 500PF 5% 0 TO+70PPM/C 500V	CD15FD501J03	CDE	101 1500	1
C1	CAP, TANT, 10UF 20% 20V	T368B106M025AS	KEMET	109.6100	1
C3	CAP, TANT, 68UF 20% 6V	T368B68M006AS	KEMET	109.6680	1
R1	RES, CFLM 150 OHM 5% 1/4W			116.1151	1
U3 U4 U5 U6	U: DUAL PRPHL DRIVER (75451)	SN75451N-3	TI	120.4451	4
NONE	ASSY, PC BD PREPPED 816-0810	816-2686	WVTK	1208-00-2686	1
U11 U24 U27	U: QUAD 2 IN MPLX (74157)	N74157N-B	SIG	122.0112	3
U12 U7	U: QUAD 2 IN NAND GATE	SN7400N-3	TI	122 7400	2
U10 U17 U18 U19 U25 U8	U: HEX INVERTER	DM7404N/A+	NSC	122.7404	6
U1 U20 U21 U22 U23 U26 U28	U: QUAD 2 IN NAND BUFFER	SN7437N-3	TI	122.7437	7
U2	U: QD 2 IN NAND	N7438N-B	SIG	122.7438	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	ASSY, PRE WAVE LOAD 816-0800	1208-00-2685	

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
	BUFFER O/C				
U29 U30	U: DUAL 4 IN NAND BUFFER	DM7440N/A+	NSC	122 7440	2
U13 U14 U15 U16	U: BCD TO DECIMAL DECODER	N7442N-B	SIG	122.7442	4
U9	U: DUAL 2 IN 2W AOI GATE	SN7451N-3	TI	122.7451	1
R3	U: PULL UP NET 150 OHM 2% X15	316A151	AB	128.1151	1
R2 R4 R5	U: PULL UP NET 3 3K 2% X13	4114R-002-332	BOURN	128 2330	3
CR1 CR2	SL LW LK 70PIV 200MW (1N457)			132 0457	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0800	1208-00-2685	

PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
VR1	Q: P.V REG 5V 5% 1A TO-3	LM309K-STEEL	NSC	120 0051	1
REF	ASSY, PRE WAVE LOAD 816-0800	816-2685	WVTK	1208-00-2685	1
DS1 DS10 DS11 DS12 DS13 DS14 DS15 DS16 DS2 DS3 DS4 DS5 DS6 DS7 DS8 DS9	LED: RED, 2MCD@10, 40DVA	MV5054-1	MONBO	171.1600	16
S1 S10 S11 S12 S14 S15 S16 S2 S3 S4 S5 S6 S7 S8 S9	S: TOG SPDT ON-ON PC SFB	7101-P3-YCB	C&K	340.1202	15
S13	S: TOG SPDT ON-OFF-MOM PC SFB	7107-P3-Y-C-B	C&K	340.1203	1
NONE	CONN, PLUG: RIGHT ANGLE	460-1521-02-03-00	CAMBN	352.0102	2
NONE	HEAT SINK: TO-3 U 234H	6104B	THERM	367.0403	1
NONE	M SCR ST ZN PH 4-40 X 1/2 PH			381 4082	2
NONE	NUT, HX BT ZN 4-40X1/4 AF			387 4080	2
NONE	WASHER, EXT LK STL ZN #4			388 1041	4

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	SCANNER ASSY 816	004 0810	F

PAGE 1

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: PARTS LIST SCANNER ASSEMBLY
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG.		MODEL NO: 816 DWG NO: 004 0810 REV: F
	SCALE		SIZE: A DWG NO: 23338 SHEET 1 OF 1

BISHOP GRAPHICS-ACCUPRESS REORDER NO. A2708

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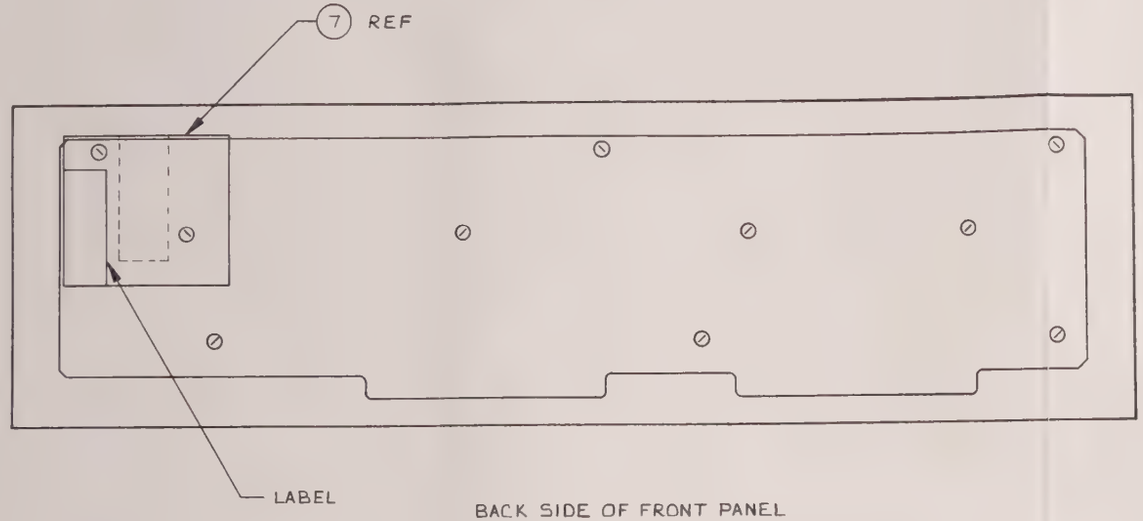
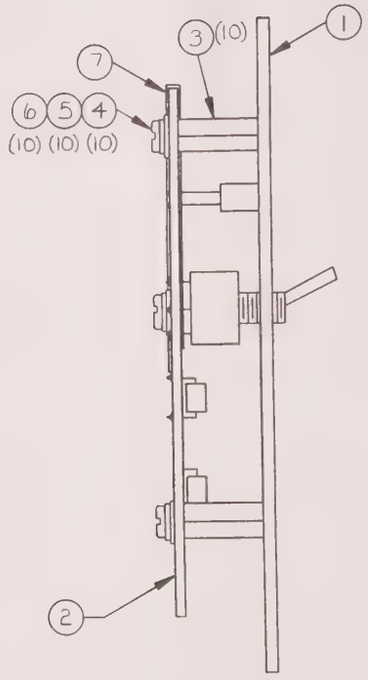
REV	ECN	BY	DATE	APP
A	RELEASE			
B	693			
C	7894			



BACK SIDE OF FRONT PANEL



SCALE 2:1

REFERENCE DESIGNATORS	PART DESCRIPTION	DRIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
2	SCANNER ASSY 816			004.0810	1
7	SHIELD, LINE VOLTAGE PROTECTION	1400-02-2410	WVTK	1400-02-2410	1
1	FRONT PANEL: 816			300.0801	1
NONE	LABEL: CAUTION, 1488A			371.1012	1
6	M SCR: ST ZN BL 4-40X1/4 PH			380.4041	10
4	WASHER: FLAT STL ZN #4			388.0040	10
5	WASHER: EXT LK STL ZN #4			388.1041	10
3	SPR: THD 1/4HX 4-40X5/8	8835	SMITH	389.2006	10

WAVETEK PARTS LIST	TITLE: PANEL ASSEMBLY FRONT 816	ASSEMBLY NO. 001 0800	REV C

PAGE 1

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE 9/18/74	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL N/A	PROJ ENGR		TITLE: SYSTEM 816 FRONT PANEL ASSEMBLY
FINISH WAVETEK PROCESS N/A	RELEASE APPROV RDW		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG	MODEL NO 816	DWG NO 02-001-0800 REV C
	SCALE 1:1	CODE IDENT 23338	SHEET 1 OF 1

BISHOP GRAPHICS ACCUPRESS RECORDER NO. A2788

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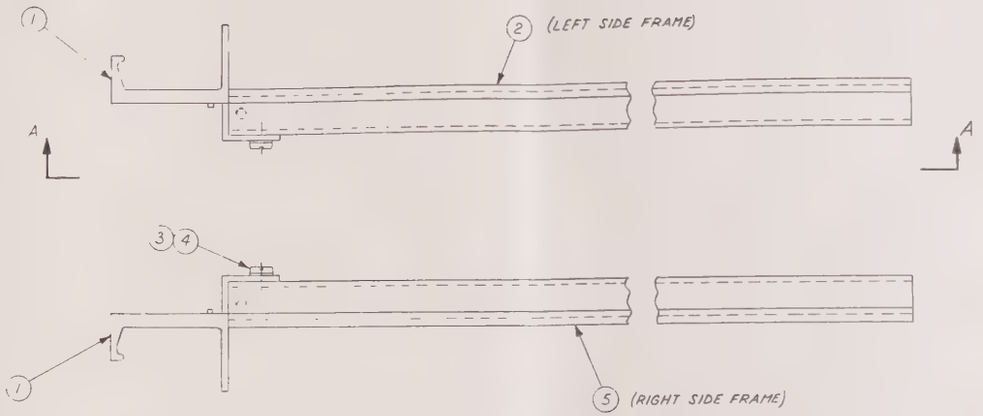
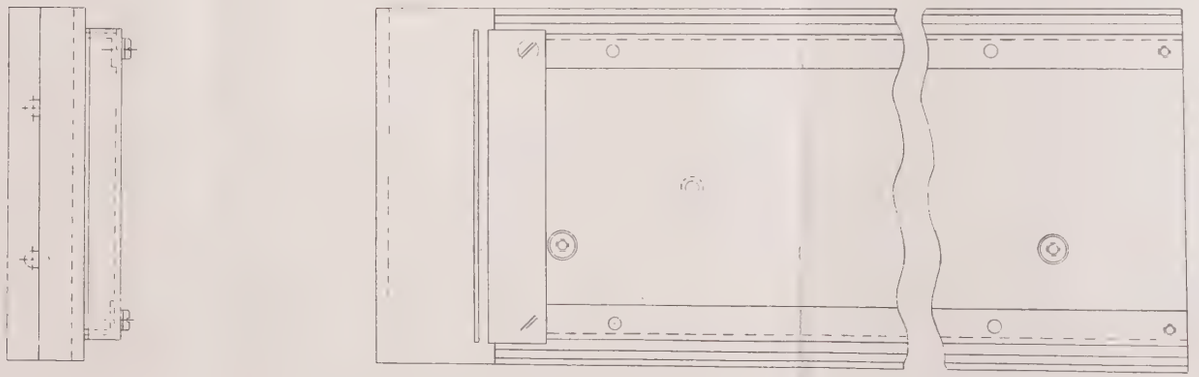
LTR	ECO NO	CHANGED BY	APPVD BY	DATE
A	RELEASE		[illegible]	5-5-97





VIEW A-A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ADAPTOR: RACK MOUNTING	MP40110-2	BURKEY	304 0400	2
NONE	SIDE FRAME: 816	MP40423	BURKEY	304 0501	2
NONE	M SCR: ST ZN SL 8-32X3/8 PH			380 8062	4
NONE	WASHER: EXT LK STL ZN #8			388 1081	4

WAVETEK PARTS LIST	TITLE: SIDE FRAME ASSY 816	ASSEMBLY NO.: 002 0865	REV: A
		PAGE 1	

DRAWN BY: S.J.	DATE: 4-28-97	WAVETEK
CHECKED BY:		
ENG APPVL: [illegible]		
MFG APPVL:		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE: .XXX ± .XX ± X/n ± 1/64 ∠° ± 1°

TITLE: SIDE FRAME ASSEMBLIES G.D.

SIZE: D | DRAWING NO.: 22 002 0527 | REV: A | SCALE: 1

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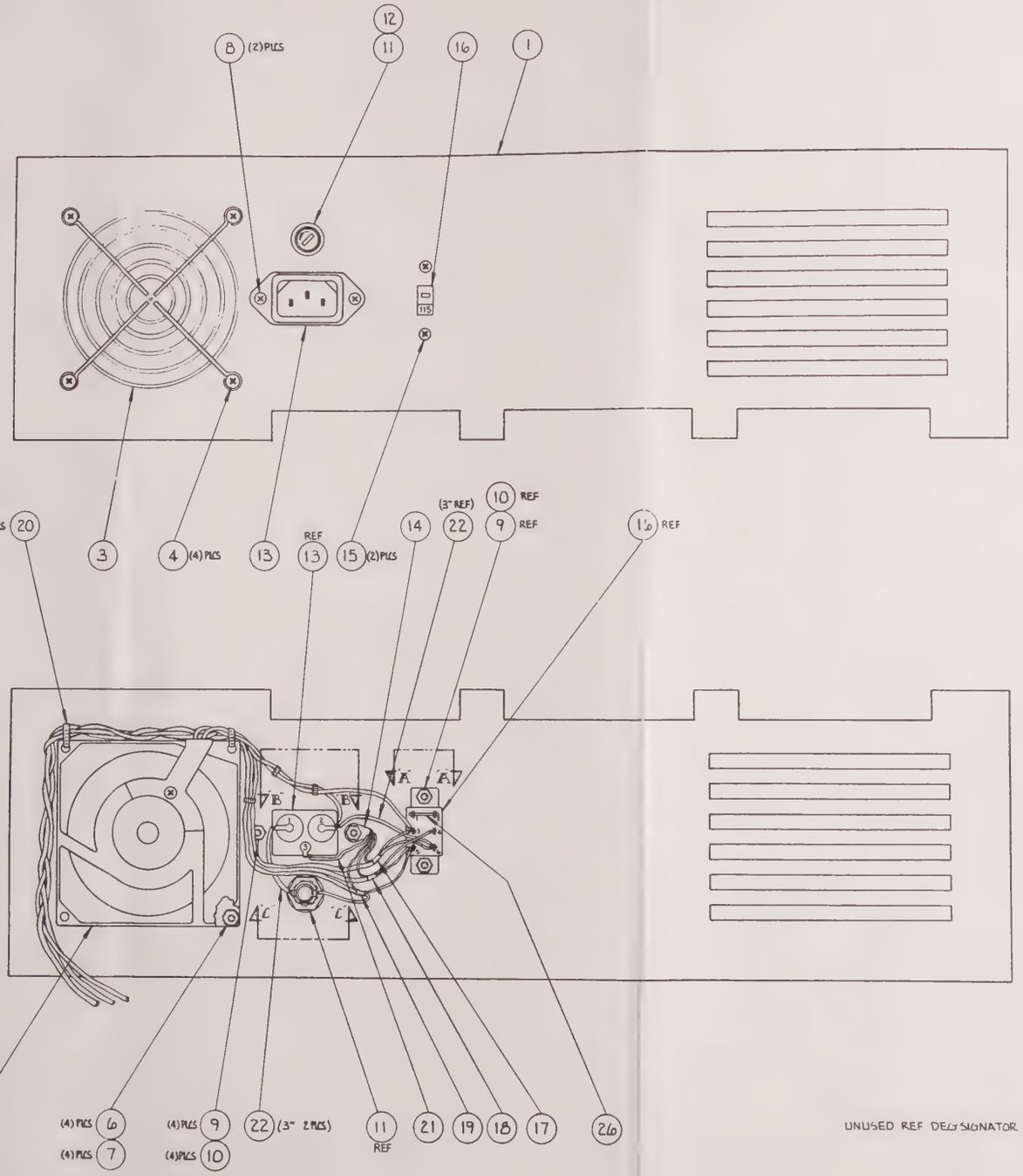
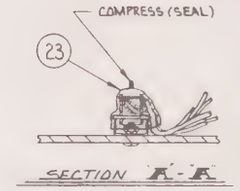
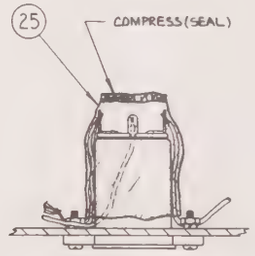
REV	ECO	REV	ECN	BY	DATE	APP
A	RELEASE	B	9296	CD	10/23/86	K&B
B	262	H	9211	[illegible]	11/4/87	[illegible]
C	692					
D	922					
E	2071					
F	7890					

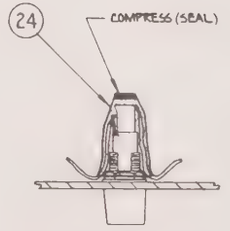




SECTION A-A



SECTION B-B



SECTION C-C

WIRE CONNECTION CHART					
REF DES.	COLOR /WIRE	FROM		TO	
		REF DES	REF NO.	REF DES.	REF NO.
17	WHT	16	3	–	–
17	BLK	16	6	–	–
17	BLK (GND)	14	–	–	–
18	WHT	16	5	–	–
18	BLK	16	4	–	–
18	BLK (GND)	14	–	–	–
19	WHT	11	2	–	–
19	BLK	16	5	–	–
19	BLK (GND)	14	–	–	–
21	GRN	13	3	14	
22	BLK	13	1	11	1
22	BLK	13	2	16	6
26	BUSS	16	1	16	2

UNUSED REF DESIGNATOR : 5

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL ~

FINISH WAVETEK PROCESS ~

DRAWN CARLOS LONTREARAS DATE 8-13-87

PROJ ENGR

RELEASE APPROV E. B. Powell

TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 XX ± .030 ANGLES ± 1

DO NOT SCALE DWG

SCALE FULL

WAVETEK SAN DIEGO, CALIFORNIA

TITLE REAR PANEL ASSEMBLY

MODEL NO 816

DWG NO 02-002-0875 REV H

CODE IDENT 23338

SHEET 1 OF 1

BISHOP GRAPHICS-ACCUPRESS REORDER NO. A27086

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
2	FAN AXL 3 1/8 115V SLV A/P	SU2A1	ROTRN	165 1701	1
13	FILTER POWER LINE 3A	3EF1	CORCM	165 3001	1
12	FUSE 3AG 2A SB 250V	313002	LITFU	165 4004	1
NONE	SUPER KIT	2500-0816-01	WVTK	2500-0816-01	1
20	TY-WRAP	TY-523M	TB	2800-00-0006	5
1	PANEL REAR 816			304 0601	1
16	SLIDE SW 115-230 SEL, DPDT, SHORT BAR INSTALLED	46256-LFR	SWCFT	342 2201	1
11	FUSE HOLDER MINI 3 AG	031 1653/031 1666	SCHUR	351 9951	1
14	LUG SOLDER ANGLED #6	1416-6	SMITH	359 0006	1
3	GUARD FAN WIRE	760-12601-43	ETRI	366 2001	1
26	WIRE BUSS HD DWN TND #20 AWG	W2020	WEICO	378 0300	5
21	WIRE #18 AWG STR GREEN	1857/19	ALPHA	378 1454	3 50
22	WIRE #24 AWG STR BLACK	1124	WEICO	378 1704	6

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	REAR PANEL ASSY 816	002 0875	H

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
8	M SCR ST ZN SL 4-40X1/2 BH			380 4081	2
4	M SCR ST ZN SL 6-32X1/2 BH			380 6081	4
15	M SCR ST ZN 4-40 X 3/8 PH			381 4062	2
10	NUT HX ST ZN 4-40X1/4 AF			[illegible]	4
7	NUT HX ST ZN 6-32X1/4 AF			387 6080	4
9	WASHER INT LK STL ZN #4			388 1040	4
6	WASHER EXT LK STL ZN #6			388 1061	4
25	SLEEVING, SHRINKABLE, 1 1/2 IN	QPO-135, 1 1/2	RMTEK	6001-20-2400	1 5
24	SHRINK, CLEAR, 3/4	FP-301-3/4	ELCHC	6001-21-2000	1 5
23	SHRINK, CLEAR 1	FP-301-1	ELCHC	6001-21-6000	8

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	REAR PANEL ASSY 816	002 0875	H

PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: PARTS LIST REAR PANEL ASSEMBLY
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG		MODEL NO 816 / DWG NO 002.0875 / REV H
	SCALE		ORDER 23338 / SHEET 1 OF 1

BISHOP GRAPHICS ACCUPRESS REORDER NO A27884

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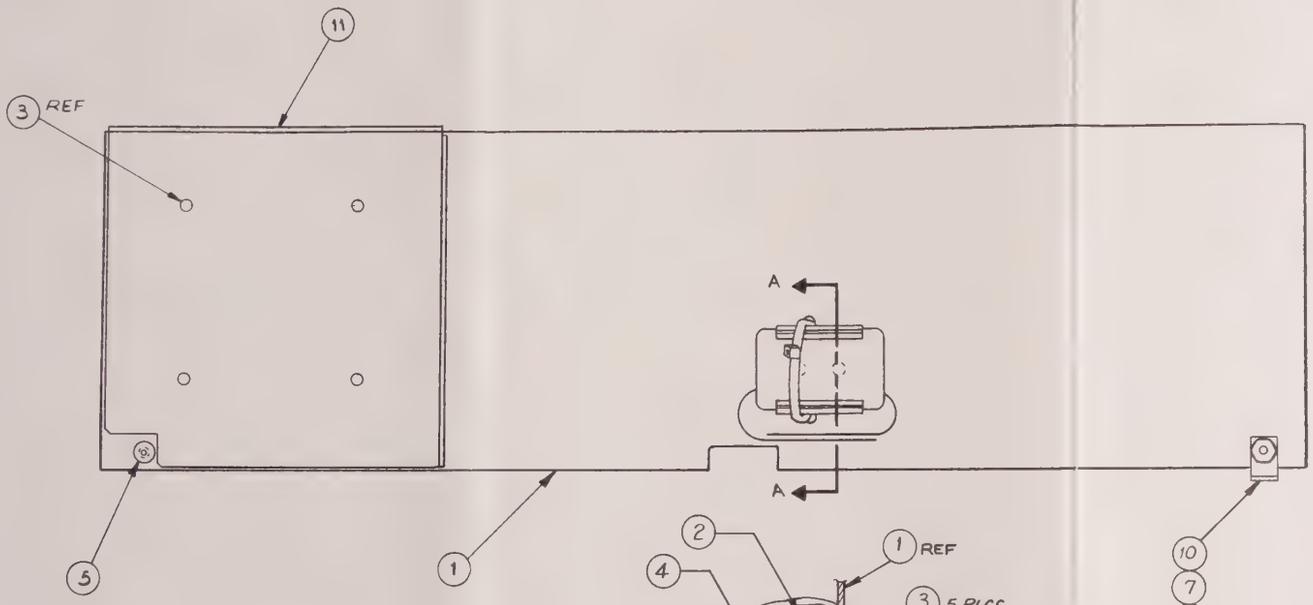
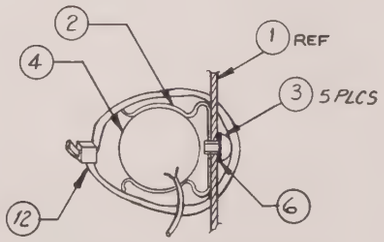
REV	ECO	BY	DATE	APP
A	RELEASE			
B	691	WNT 11-11-76	11-11-76	RDH
C	919	SJS 9-25-78	5-5-78	JV
D	7931	M.C. 3-26-87	4/4/87	RBG
E	9316	M.C. 11-17-87	11/25/87	ABH





PARTIAL SECTION A-A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
4	CAP, PAPER, .47UF 10% 600V	6P8-P47	SPRGE	103 4470	1
11	SHIELD, MU METAL, 816	1400-02-2540	WVTK	1400-02-2540	1
12	TIE STRAP	SST-1 3M	PANDT	2800-00-0003	1
3	RIVET 1/8X3/16L	1125-0406	AVDEL	2800-12-0011	5
6	SCREW, 6-32 BAE FLAT WASHER, .375 O D	6 SAE FLAT WASHER	CMRCL	2800-26-6000	1
1	SHIELD PLATE			304 0903	1
2	CLIP, COMP MTG .437 X 1.00	6080-7A	AUGAT	362 2004	1
7	M XCR ST ZN BL 4-40X3/8 PH			380 4062	1
8	NUT HX ST ZN 4-40X1/4 AF			387 4080	1
9	WASHER INT LK STL ZN #4			388 1040	2
5	NUT CLINCH STL ZN 4-40 .031 THK			389 1002	1
10	BKT ANG ST ZN 1/2X1/2			389 3002	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	SHIELD PLATE ASSY 816	002 0870	E

PAGE 1

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M.L. Caldwell	DATE 5-26-87	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	CHECKED D. BUZZELL	6/18/87	TITLE: POWER SUPPLY SHIELD PLATE ASSEMBLY
	PROJ. ENGR.		
FINISH WAVETEK PROCESS	RELEASE APPROV R.B. Brand	6/3/87	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ±1/64 DECIMALS .XX ±.03 .XXX ±.010 ANGLES ±1°		SIZE C | FSCM NO. 23338 | DWG. NO. 02-002-0870 | REV E; SCALE FULL | MODEL 816

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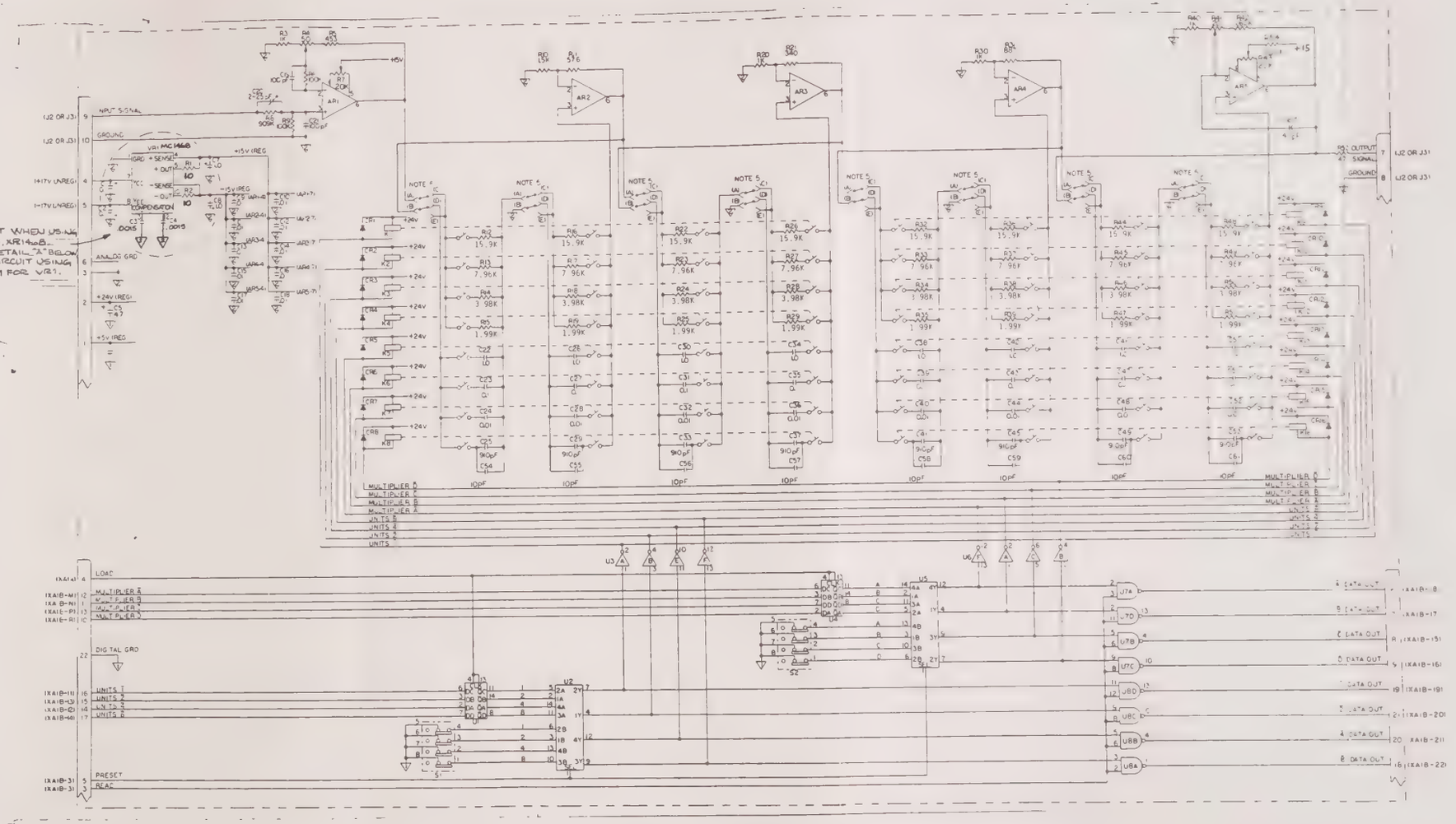
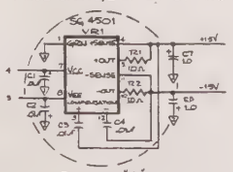
LTR	ECO NO	CHANGED BY	APPVD BY	DATE
A	RELEASE	[illegible] 11-19-76	[illegible]	11-19-76
B	514	[illegible] 4/76	[illegible]	4-15-76
C	712	WNT 12/2076	[illegible]	1/4/77
D	914	SJS 4-11-78	[illegible]	5/4/78
E	936	TJN 7/78	[illegible]	7/19/78
F	1015	JB 8-27-79	[illegible]	9/8/79
G	1112	[illegible] 2/17/81	[illegible]	2/17/81
H	7819	SD 11-21-86	[illegible]	11-21-86



6-STANDARD IC USED FOR VR1 IS A MC1468, XR1468. WHEN USING SG4501 IN THE VR1 POSITION; NOTE THE VALUE CHANGE OF CB & C4 AND CIRCUITRY CHANGE.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS. ALL CAPACITOR VALUES ARE IN MICROFARADS.

2. JUMPERS ARE SHOWN IN LOW PASS CONFIGURATION. PIN A TO PIN C AND PIN B TO PIN D. FOR HIGH-PASS CONFIGURATION CONNECT PIN A TO PIN D AND PIN B TO PIN E. ALL JUMPERS MUST BE CONNECTED THE SAME WAY.

HIGHEST REF DESIG USED:
AR5 C63 CR16 K16 R54 S2 U8 VR1

IC REF DES	
U1	122-7475
U2	0112
U3	7406
U4	7475
U5	0112
U6	7406
U7	7401
U8	122 7401

DRAWN BY: RCP	DATE 11-19-76	WAVETEK
CHECKED BY: [illegible]		
ENG APPVL. [illegible]		
MFG APPVL. [illegible]		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE: .XXX ±, .XX ±, X/X ± 1/64, ∠° ± 1°

TITLE: SCHEMATIC DIAGRAM FILTER CARD BUTTERWORTH 10Hz-150KHz

SIZE D | DRAWING NO. 03 004-0830 | REV H

SCALE | SHEET 1 OF 1

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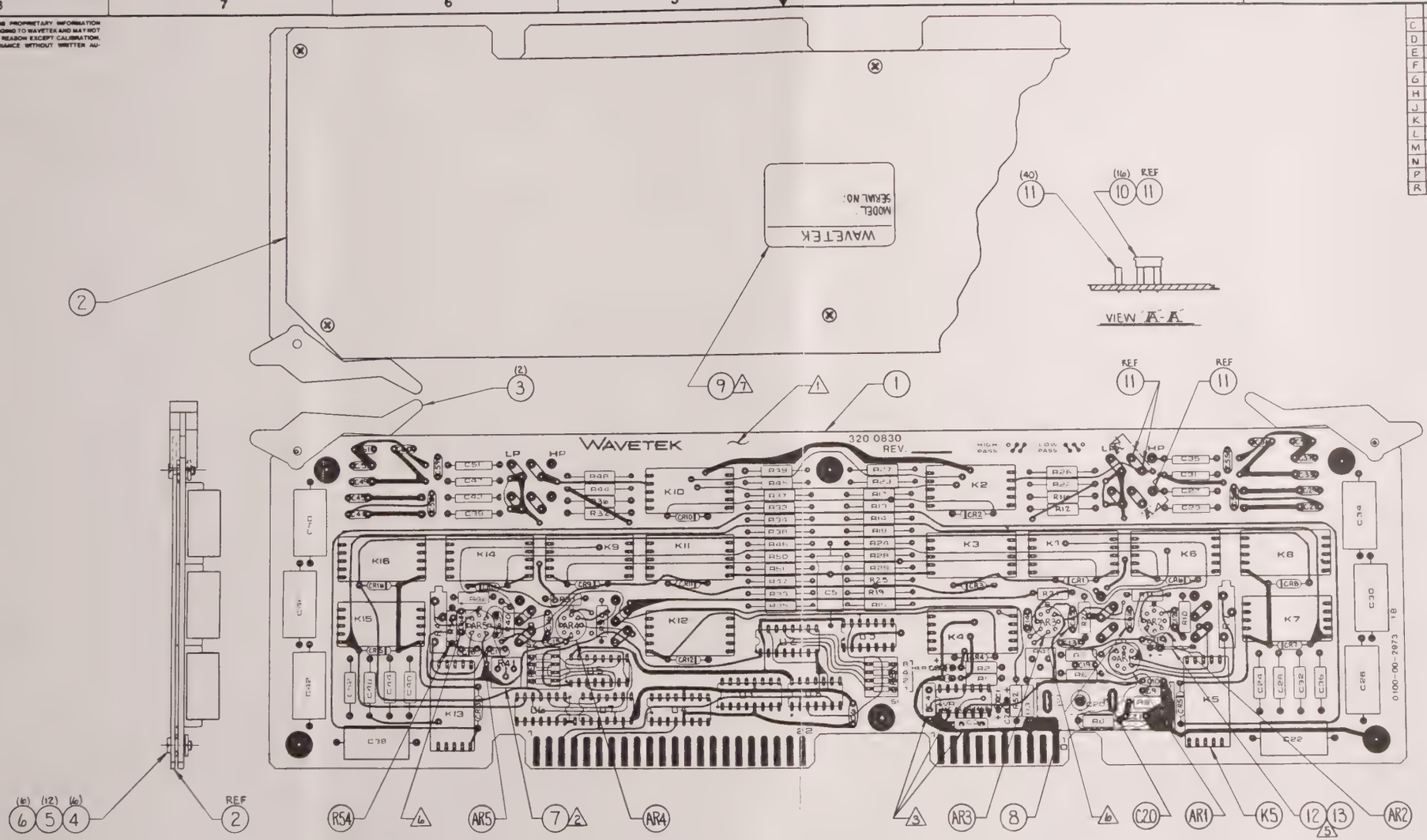
C	157
D	264
E	455
F	513
G	703
H	914
J	936
K	1015
L	1132
M	1154
N	1169
P	2236
R	8210

REV	ECO	BY	DATE	APP
S	9259 REDRAWN	CC	1/11	



⚠1 SERIAL NUMBER TAG IS CENTERED ON PLATED SIDE OF SHIELD.

⚠6 SELECT C64, C65, & C66 IN TEST.

⚠5 CONNECT JUMPER TO +SUPPLY FOR OP AMP #120-1014 & 120-1007.

4. LEAD PROTRUSION THRU BOARD TO BE .062 MAX.

⚠3 STANDARD COMPONENTS SHOWN, FOR ALTERNATION USE AS A GROUP VR1 SG 4501 P.N. 120-0157, C3 & C4 .01 µf P.N. 100-3101.

⚠2 RANGE-MULTIPLIER LABEL ITEM 7 IS TRIMMED TO FIT R41. SELF ADHESIVE, HOLDS LABEL IN PLACE AFTER R41 IS ADJUSTED. FOR 004-0830 ASSEMBLY, TRIM LABEL TO SHOW X10, X100, X1K, & X10K.

⚠1 STAMP APPLICABLE PART NUMBER AND REVISION LETTER PER INK SPEC DWG. NO. 00-995-0001 APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN: ARLOS CONTRERAS 12/8/87
CHECKED: 1/11/88
PROJ. ENGR.
RELEASE APPROV: 1/11/88
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
XX: ±
XXX: ±

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: P.C.B. ASSEMBLY, 10 Hz-150 KHz BUTTERWORTH FILTER

SIZE	FSCM NO	DWG NO	REV
D	23338	02-004-0830	S

SCALE 1 1/2 : 1 | MODEL 814 | SHEET 1 OF 1

REV	ECN	BY	DATE	APP

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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C10 C11 C12 C13 C14 C15 C16 C17 C18 C9	CAP,MOND, .01UF +80 -20% 50V	SR215E103ZAT	AVX	100.3105	10
C6	CAP,MOND, 0.1UF 50V Z5U	SR215E104ZAT	AVX	100 4102	1
C54 C55 C56 C57 C58 C59 C60 C61	CAP MICA FX VAL DIP 10PF 5% 200PPM/C 500V	CM05CD100J03	CDE	101.0100	8
C63	CAP MICA FX VAL DIP 47PF 5% -20+100PPM/C 500V	CM05ED470J03	CDE	101.0470	1
C19 C21	CAP FX VAL,DP MICA 100PF 5% 0 TO +70PPM/C 500V	CM05FD101J03	CDE	101.1100	2
C25 C29 C33 C37 C41 C45 C49 C53	CAP MICA FX VAL DIP 910PF 1% 0 TO+70PPM/C 100V	CD15FA911F03	CDE	101.1910	8
C24 C28 C32 C36 C40 C44 C48 C52	CAP,POLYSTY,EPOXY CASE, A/L 0.01UFD 1%,100V	PSBPC1103F	AMRAD	104.3104	8
C23 C27 C31 C35 C39 C43 C47 C51	CAP,POLYCARB, .1UF 1% 100V	C31B104F	BISHO	104.4100	8
C22 C26 C30 C34 C38 C42 C46 C50	CAP,POLYCARB, 1.0UF 1% 100V	C3113 105F	BISHO	104.5100	8
C3 C4	CAP,PLSTR, .0015UF 10% 100V	223P15291WD3	SPRGE	105.2150	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0830	1208-00-2687	

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
R14 R18 R24 R28 R34 R38 R44 R50	RES,MFLM 3.98K 1% 1/8W TO	CR125 100PPM	CTLRE	111.3980	8
R13 R17 R23 R27 R33 R37 R45 R49	RES,MFLM 7.96K 1% 1/8W TO	CR125 100PPM	CTLRE	111.7960	8
R12 R16 R22 R26 R32 R36 R44 R48	RES,FX MFLM 15.9K 1% 1/8W TO	CR125 100PPM	CTLRE	112.1590	8
R6 R9	RES,MFLM 100K 1% 1/10W T2	RN55C1003F	UNCEM	113.1001	2
R54	RES,MFLM 200K 1% 1/10W T2	RN55C2003F	UNCEM	113.2001	1
R8	RES,MFLM 909K 1% 1/8W TO	RN55C9093F	ROHM	113.9090	1
R1 R2	RES,CFLM 10 OHM 5% 1/4W			116.0101	2
R52	RES,CFLM 47 OHM 5% 1/4W			116.0471	1
R41	RES, VAR CMT 20 OHM 3/8W PM	72PR20	BECK	118.0200	1
R4	RES, VAR CMT 50 OHM 3/8W PM	72PR50	BECK	118.0500	1
R7	RES, VAR CMT 20K 3/4" RECT	3006P1-203	BOURN	118.3200	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0830	1208-00-2687	

PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	ELECT SCHEMATIC FILTER (816-01)	03 004 0830	WVTK	03.004.0830	1
R54	RES,MFLM 200K 1% 1/10W T2	RN55C2003F	UNCEM	113.2001	1
AR4 AR5	U: LIN OP-AMP FET IN LH0062CH	LH0062CH	NSC	120.1007	2
AR1 AR2 AR3	U: LIN OP-AMP (LF-356)	LF-356HC	TI	120.1014	3
NONE	ASSY, PRE WAVE LOAD 816-0830	816-2687	WVTK	1208-00-2687	1
NONE	LABEL,SERIAL NUMBER/FILTERS & SYNTHESIZERS	FSS-8660	WVTK	1400-01-8660	1
NONE	RELAY: REED 4PST 24V 180MW	1503-12-1	MABSH	175.1503	1
NONE	SHLD. INPUT FILTER CARD 816			304.0906	1
NONE	PC: SHIELD (B16FC)			320.0840	1
NONE	CONN, PLUG: SHORTING (LOW PROF)	4612872-01-03-10	CTC	352.0202	16
NONE	SOCKET: JMPR (USE W/352.0202)	4303327-01-0300	CTC	353.0104	40

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	OPTION 001 FILTER CARD,BUTTERWORTH,	004 0830	R

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C20	CAP,VAR MICA, 2-25PF 175V	421	ARCO	108 0250	1
C1 C2	CAP,TANT, 10UF 20% 35V	T368A104M035A*	KEMET	109 4100	2
C7 C8	CAP,TANT, 1.0UF 20% 35V	T368A105M035AS	KEMET	109 5100	2
C5	CAP,ELECT, 47UF 20% 63V	47763-81009	BIEM	109 6470	1
R21	RES,MFLM 340 OHM 1% 1/10W T2	RN55C3400F	UNCEM	110.3401	1
R5	RES,MFLM 453 OHM 1% 1/8W TO	RN55C4530F	UNCEM	110 4530	1
R31	RES,MFLM 887 OHM 1% 1/8W TO	RN55C8870F	UMCEM	110 8870	1
R20 R3 R30 R40	RES,MFLM 1.00K 1% 1/10W T2	RN55C1001F	UMCEM	111 1001	4
R10	RES,MFLM 1.50K 1% 1/10W T2	306JJD1K500F	MEPCO	111.1501	1
R42	RES,MFLM 1.62K 1% 1/8W TO	RN55C1621F	UMCEM	111 1620	1
R15 R19 R25 R29 R35 R39 R47 R51	RES,MFLM 1.99K 1% 1/8W TO	CR125 100PPM	CTLRE	111 1990	8

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0830	1208-00-2687	

PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R43	RES, VAR CMT 200K 3/4" RECT	3006P1-204	BOURN	118.4200	1
R11	RES,MFLM 57.6 OHM 1% 1/8W TO	RN55C57R6F	UMCEM	119.5760	1
VR1	U: DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120.0132	1
NONE	ASSY, PC BD PREPPED 816-0830	816-2688	WVTK	1208-00-2688	1
U2 U5	U: QUAD 2 IN MPLX (74157)	N74157N-B	SIG	122.0112	2
U7 U8	U: QUAD 2 IN NAND GATE O/C	DM7401N/A+	NSC	122 7401	2
U3 U6	U: HEX INVERT DRIVER O/C	SN7406N-3	TI	122 7406	2
U1 U4	U: 4 BIT LATCH	SN7475N-3	TI	122 7475	2
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	SL LW LK 70PIV 200MW (1N457)			132 0457	16
K1 K10 K11 K12 K13 K14 K15 K16 K2 K3 K4 K6 K7 K8 K9	RELAY: REED 4PST 24V 180MW	1503-12-1	MABSH	175 1503	15
S1 S2	S DIP 4 POLE 2 POS	76S804	DRAHL	342 4100	2
NONE	SOCKET I.C. TO-5	8059-297	AUGAT	353.0801	5

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0830	1208-00-2687	

PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	EJECTOR: PC (B16)	9-209	SCAMB	364 0402	2
NONE	LABEL: MULT. PROG SWITCH			371 1002	1
NONE	M XCR ST ZN SL 4-40X3/8 PH			380 4062	6
NONE	NUT: HX ST ZN 4-40X1/4 AF			387 4080	12
NONE	WASHER: INT LK STL ZN #4			388 1040	6

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	OPTION 001 FILTER CARD, BUTTERWORTH,	004 0830	R

PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE
MATERIAL	PROJENGR	
	RELEASE APPROV	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX: 010 ANGLES: ± XX: 030	
	DO NOT SCALE DWG	
	SCALE	

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PARTS LIST
10 Hz – 150 kHz
BUTTERWORTH FILTER

MODEL NO	DWG NO	REV
816	004.0830	R

CODE IDENT 23338 SHEET 1 OF 1

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-3884

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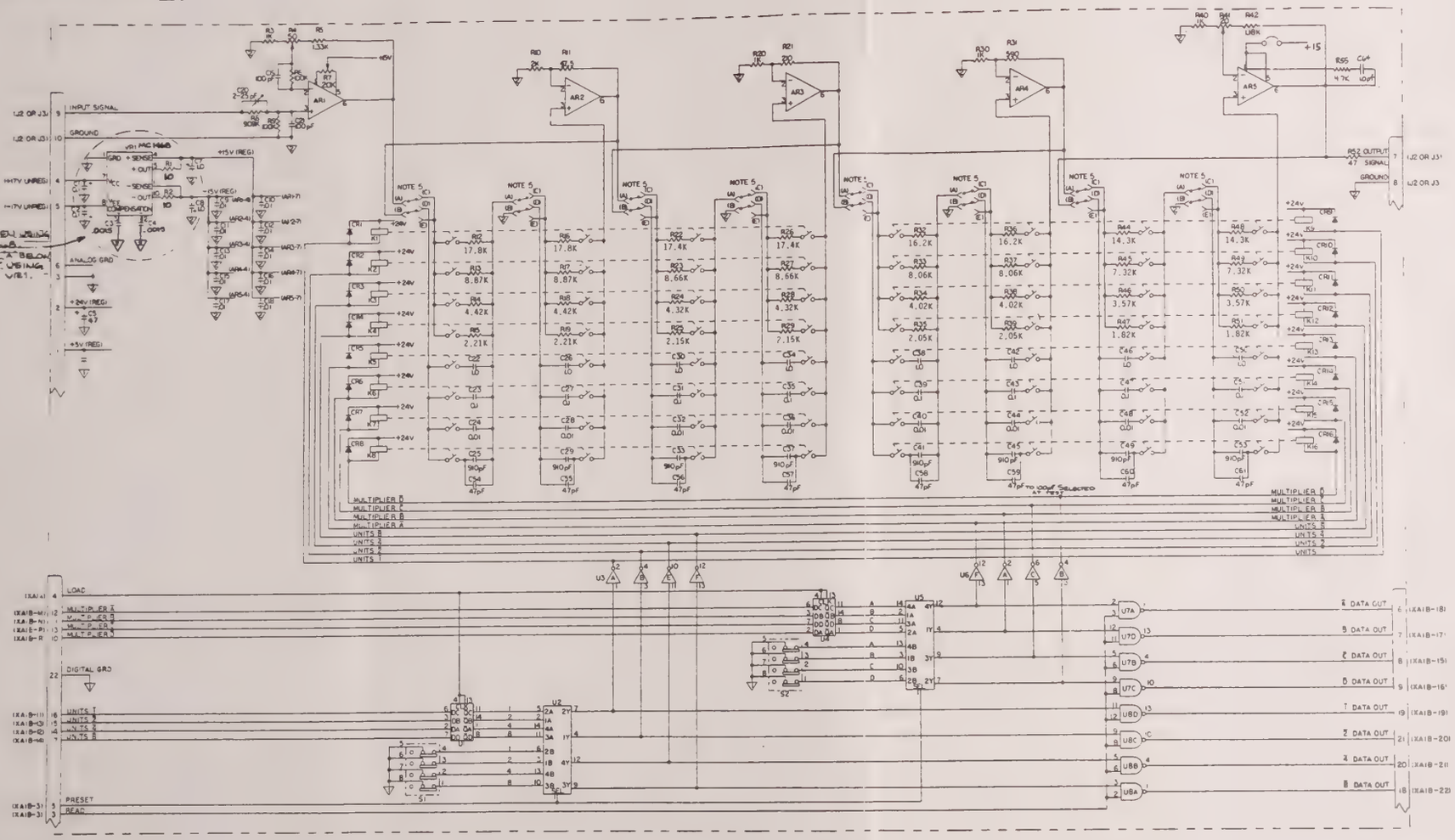
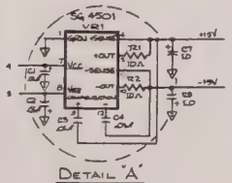
LTR	ECO NO.	CHANGED BY	APPR'D BY	DATE
A	RELEASE 7819	SD 11-19-86	MKel	11-21-86



6- STANDARD IC USED FOR VR1 IS A MC1468, XR1468, WHEN USING SG 4501 IN THE VR1 POSITION; NOTE THE VALUE CHANGE OF C3 & C4 AND CIRCUITRY CHANGE.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS. ALL CAPACITOR VALUES ARE IN MICROFARADS.

2- JUMPERS ARE SHOWN IN 'LOW' PASS CONFIGURATION. PIN A TO PIN C AND PIN B TO PIN D. FOR HIGH-PASS CONFIGURATION, CONNECT PIN A TO PIN D AND PIN B TO PIN E. ALL JUMPERS MUST BE CONNECTED THE SAME WAY.

HIGHEST REF DESIG USED:
AR5 C63 CR16 K16 R54 S2 U8 VR1

IC REF DES	
U1	122-7475
U2	0112
U3	7406
U4	7475
U5	0112
U6	7406
U7	7401
U8	122 7401

DRAWN BY		DATE 11-17-86
CHECKED BY		11-19-86
ENG APPR.		
MFG. APPVL.		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE: .XXX ± .XX ± X/x ± 1/64 ∠° ± 1°

WAVETEK

TITLE: SCHEMATIC DIAGRAM FILTER CARD BESSEL 10 Hz - 150 KHz

SIZE D | DRAWING NO. 03 004-0835 | REV A

SCALE N/A | SHEET 1 OF 1

MAKE FROM 03-004-0830 1 REV G

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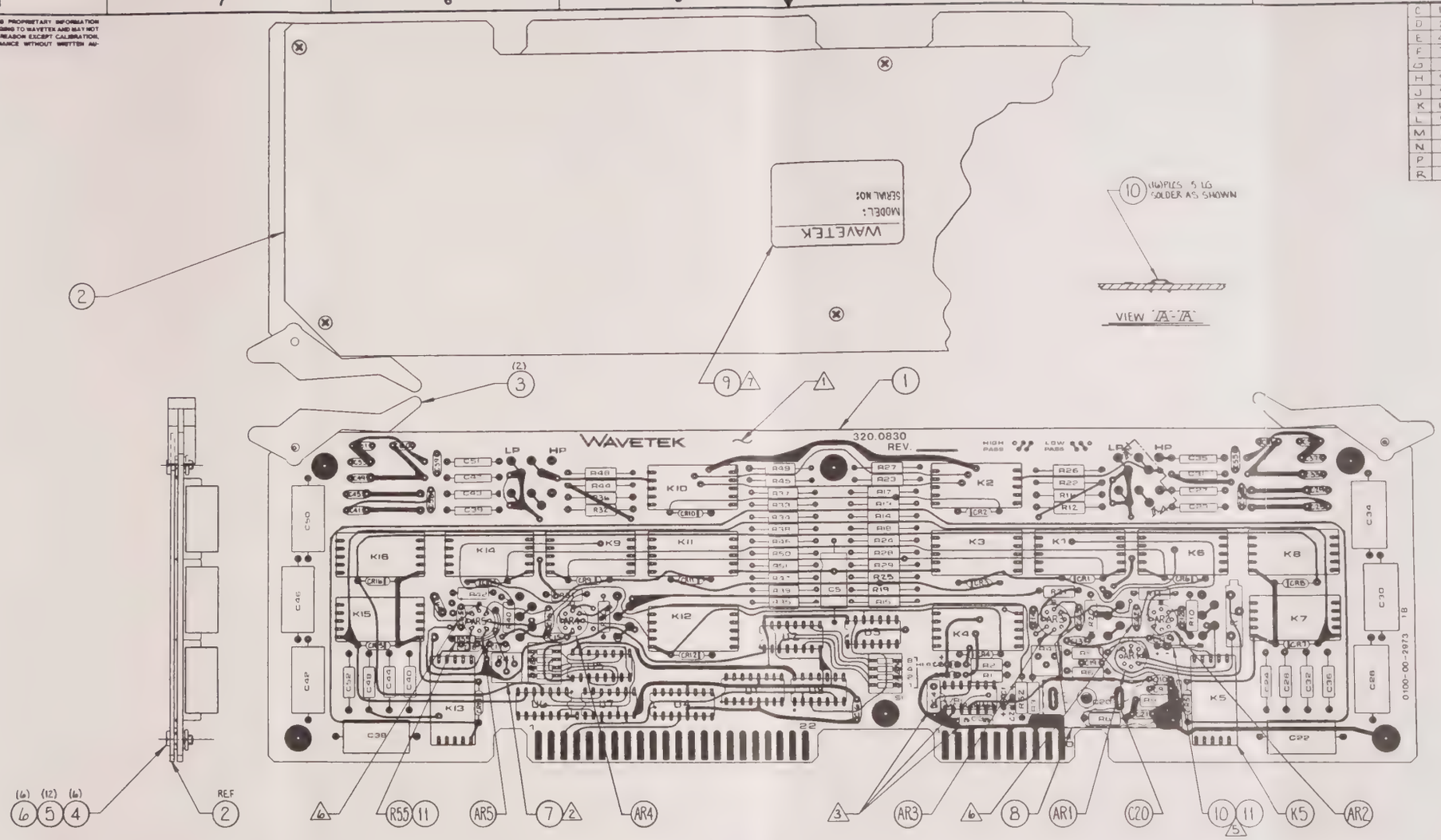
C	157
D	265
E	455
F	704
G	741
H	914
J	936
K	1015
L	1112
M	1154
N	1169
P	2135
R	8210

REV	ECO	BY	DATE	APP
S	9259 REDRAWN	CC	4/4/88	RKL



1. SERIAL NUMBER TAG IS CENTERED ON PLATED SIDE OF SHIELD.
6. SELECT C62, C63, & C65 IN TEST.
5. CONNECT JUMPER TO +SUPPLY FOR OP AMP #120-1014.
4. LEAD PROTRUSION THRU BOARD TO BE .062 MAX.
3. STANDARD COMPONENTS SHOWN, FOR ALTERNATION USE AS A GROUP VRI SG 4501 P.N.120-0157 & C3,C4 .01 µf P.N. 100-3101
2. RANGE-MULTIPLIER LABEL ITEM 7 IS TRIMMED TO FIT R41, SELF ADHESIVE HOLDS LABEL IN PLACE AFTER R41 IS ADJUSTED. FOR 004-0835 ASSEMBLY, TRIM LABEL TO SHOW X10, X100, X1K, & X10K.
1. STAMP APPLICABLE PART NO & REV LETTER PER INK SPEC DWG NO 00 995 0001 APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN ARLOS CONTRERAS 12 Nov 87
CHECKED 11/11/87
PROJ ENGR
RELEASE APPROV P.K.L 11/18/88

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±.01
.XXX ±.005

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
P.C.B. ASSEMBLY, 10Hz - 150KHz BESSEL FILTER

SIZE	FSCM NO	DWG NO	REV
D	23338	02-004-0835	S

SCALE 1 1/2 : 1 MODEL 816 SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C10 C11 C12 C13 C14 C15 C16 C17 C18 C9	CAP, MONO, .01UF +80 -20% 50V	SR215E103ZAT	AVX	100.3105	10
C6	CAP, MONO, 0.1UF 50V Z5U	SR215E104ZAT	AVX	100.4102	1
C64	CAP MICA FX VAL DIP 10PF 5% 200PPM/C 500V	CM05CD100J03	CDE	101.0100	1
C54 C55 C56 C57 C58 C59 C60 C61	CAP MICA FX VAL DIP 47PF 5% -20+100PPM/C 500V	CM05ED470J03	CDE	101.0470	8
C19 C21	CAP FX VAL, DP MICA 100PF 5% 0 TO +70PPM/C 500V	CM05FD101J03	CDE	101.1100	2
C25 C29 C33 C37 C41 C45 C49 C53	CAP MICA FX VAL DIP 910PF 1% 0 TO+70PPM/C 100V	CD15FA911F03	CDE	101.1910	8
C24 C28 C32 C36 C40 C44 C48 C52	CAP, POLYSTY, EPOXY CASE, A/L 0.01UFD 1%, 100V	PSBFC1103F	AMRAD	104.3104	8
C23 C27 C31 C35 C39 C43 C47 C51	CAP, POLYCARB, .1UF 1% 100V	C31B104F	BISHO	104.4100	8
C22 C26 C30 C34 C38 C42 C46 C50	CAP, POLYCARB, 1.0UF 1% 100V	C3113 105F	BISHO	104.5100	8
C3 C4	CAP, PLSTR, .0015UF 10% 100V	225P15291WD3	SPROE	105.2150	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	ASSY, PRE WAVE LOAD 816-05-0835	1208-00-2691	
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C1 C2	CAP, TANT, .10UF 20% 35V	T368A104M035A6	KEMET	109.4100	2
C7 C8	CAP, TANT, 1.0UF 20% 35V	T368A105M035AS	KEMET	109.5100	2
C5	CAP, ELECT, 47UF 20% 63V	47/63-B1009	SIEM	109.6470	1
R20 R3 R30 R40	RES, MFLM 100 OHM 1% 1/10W T2	RN55C1000F	ENOX	110.1001	4
R21	RES, MFLM 210 OHM 1% 1/8W TO	RN55C2100F	JMAR	110.2100	1
R31	RES, MFLM 590 OHM 1% 1/8W TO	RN55C5900F	JMAR	110.5900	1
R42	RES, MFLM 1.18K 1% 1/8W			111.1180	1
R5	RES, MFLM 1.33K 1% 1/8W TO	RN55C1131F	KAGAN	111.1330	1
R47 R51	RES, MFLM 1.82K 1% 1/8W TO	RN55C1821F	UMCEM	111.1820	2
R10	RES, MFLM 2.00K 1% 1/10W T2	RN55C2001F	UMCEM	111.2001	1
R35 R39	RES, MFLM 2.05K 1% 1/8W TO	NA	NA	111.2050	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	ASSY, PRE WAVE LOAD 816-05-0835	1208-00-2691	
		PAGE 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R25 R29	RES, MFLM 2.15K 1% 1/8W TO	NA	NA	111.2150	2
R15 R19	RES, MFLM 2.21K 1% 1/8W			111.2210	2
R46 R50	RES, MFLM 3.57K 1% 1/8W			111.3570	2
R34 R38	RES, MFLM 4.02K 1% 1/8W TO	NA	NA	111.4020	2
R24 R28	RES, MFLM 4.32K 1% 1/10W T2	RN55C4321F	UMCEM	111.4321	2
R14 R18	RES, MFLM 4.42K 1% 1/8W TO			111.4420	2
R45 R49	RES, MFLM 7.32K 1% 1/10W T2	RN55C7321F	NA	111.7321	2
R33 R37	RES, MFLM, 8.06K 1% 1/8W TO	RN55C8061F	UMCEM	111.8060	2
R23 R27	RES, MFLM 8.66K 1% 1/8W TO	RN55C8661F	UMCEM	111.8660	2
R13 R17	RES, MFLM 8.87K 1% 1/8W TO	RN55C8871F	NA	111.8870	2
R44 R48	RES, MFLM 14.3K 1% 1/8W TO	RN55C1432F	ENOX	112.1430	2
R32 R36	RES, MFLM 16.2K 1% 1/8W TO	RN55C1622F	UMCEM	112.1620	2
R22 R26	RES, MFLM 17.4K 1% 1/8W TO	RN55C1742F	UMCEM	112.1740	2
R12 R16	RES, MFLM 17.8K 1% 1/8W TO	RN55C1782F	UMCEM	112.1780	2
R6 R9	RES, MFLM 100K 1% 1/10W T2	RN55C1003F	UMCEM	113.1001	2
R8	RES, MFLM 909K 1% 1/8W TO	RN55C9093F	ROHM	113.9090	1
R1 R2	RES, CFLM 10 OHM 5% 1/4W			116.0101	2
R52	RES, CFLM 47 OHM 5% 1/4W			116.0471	1
R4	RES, VAR CMT 50 OHM 3/8SQ FM	72PR50	BECK	118.0500	1
R41	RES, VAR CMT 100 OHM 3/8SQ FM	72PR100	BECK	118.1101	1
R7	RES, VAR CMT 20K 3/4" RECT	3006P1-203	BOURN	118.3200	1
R11	RES, MFLM 47.5 OHM 1% 1/8W TO	RN55C47R5F	UTRON	119.4750	1
VR1	IC: DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120.0152	1
NONE	ASSY, PC BD PREPPED 816-05-0835	816-05-2692	WVTK	1208-00-2692	1
U2 U5	U: QUAD 2 IN MPLX (74157)	SN74157N-B	SIG	122.0112	2
U7 U8	U: QUAD 2 IN NAND GATE O/C	DM7401N/A+	NSC	122.7401	2
U3 U6	U: HEX INVERT DRIVER+ O/C	SN7406N-3	TI	122.7406	2
U1 U4	U: 4 BIT LATCH	SN7475N-3	TI	122.7475	2
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	SL LW LK 70PIV 200MW (1N457)			132.0457	16
K1 K10 K11 K12 K13 K14 K15 K16 K2 K3 K4 K6 K7 K8 K9	RELAY: REED 4PST 24V 180MW	1503-12-1	WABSH	175.1503	15
S1 S2	S: DIP 4 POLE 2 POS	76SB04	GRAHL	342.4100	2
NONE	SOCKET: I.C. TO-5	9039-207	AUGAT	353.0801	5

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	ASSY, PRE WAVE LOAD 816-05-0835	1208-00-2691	
		PAGE 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SCHEMATIC, FILTER CARD "BESSEL" 10HZ-150KHZ	03.004.0835	WVTK	03.004.0835	1
C20	CAP, VAR MICA, 2-25PF 175V	421	ARCO	108.0230	1
R55	RES, CFLM 4.7K OHM 5% 1/4W	R25JE4.7K	ROHM	116.2471	1
AR2 AR3 AR4 AR5	U: LIN OP-AMP FET IN LH0062CH	LH0062CH	NSC	120.1007	4
AR1	U: LIN OP-AMP (LF-356)	LF-356MC	TI	120.1014	1
NONE	ASSY, PRE WAVE LOAD 816-05-0835	816-05-2691	WVTK	1208-00-2691	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	FS8-8660	WVTK	1400-01-8660	1
K5	RELAY: REED 4PST 24V 180MW	1503-12-1	WABSH	175.1503	1
NONE	SHLD: INPUT FILTER CARD 816			304.0906	1
NONE	PC: SHIELD (816FC)			320.0840	1
NONE	EJECTOR: PC (816)	8-209	SCANB	364.0402	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	OPTION 005 FILTER CARD BESSEL FOR MODEL 816-11	004.0835	R
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	LABEL: MULT. PROG SWITCH			371 1002	1
NONE	WIRE: BUSS TINNED 22GA	9022	BELCO	378 0601	12
NONE	M XCR ST ZN SL 4-40X3/8 PH			380 4062	6
NONE	NUT: HX ST ZN 4-40X1/4 AF			387 4080	12
NONE	WASHER: INT LK STL ZN #4			388.1040	6

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	OPTION 005 FILTER CARD BESSEL FOR MODEL 816-11	004 0835	R
		PAGE 2	

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST 10 Hz – 150 kHz BESSEL FILTER
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG	MODEL NO 816	DWG NO 004.0835 REV R
	SCALE	CODE IDENT 23338	SHEET 1 OF 1

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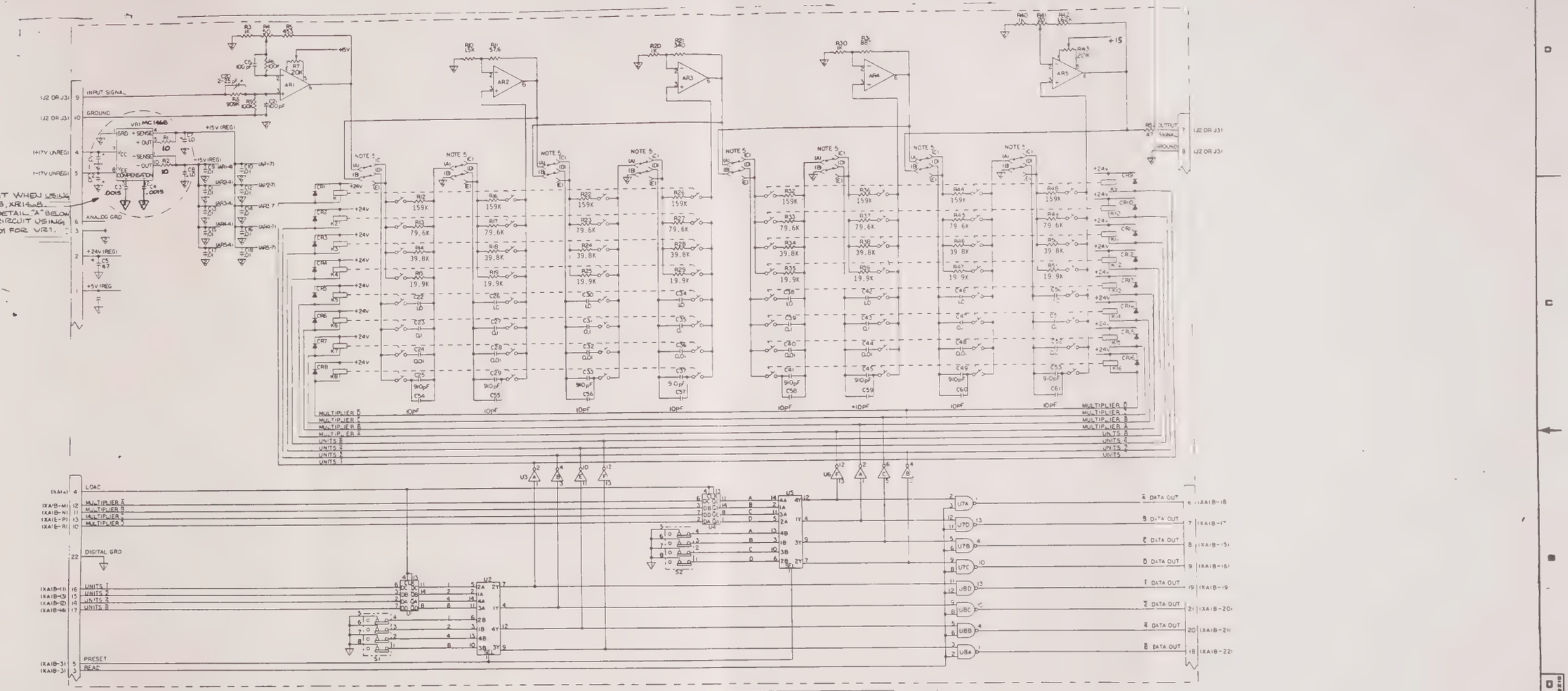
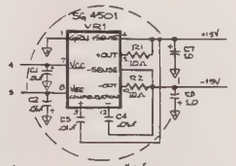
LTR	ECO NO.	CHANGED BY	APPV'D BY	DATE
A	RELEASE 1819	SD11-18-86	mcl	11-21-86



6- STANDARD IC USED FOR VR1 IS A MC1468, XR1468. WHEN USING SG 4501 IN THE VR1 POSITION; NOTE THE VALUE CHANGE OF C3 & C4 AND CIRCUITRY CHANGE.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS. ALL CAPACITOR VALUES ARE IN MICROFARADS.

2- JUMPERS ARE SHOWN IN LOW PASS CONFIGURATION. PIN A TO PIN C AND PIN B TO PIN D FOR HIGH-PASS CONFIGURATION CONNECT PIN A TO PIN D AND PIN B TO PIN E. ALL JUMPERS MUST BE CONNECTED THE SAME WAY.

HIGHEST REF DESIG USED:
AR5 C63 CR16 K16 R54 S2 U8 VR1

IC REF DES	
U1	122-7475
U2	0112
U3	7406
U4	7475
U5	0112
U6	7406
U7	7401
U8	122 7401

		DATE
DRAWN BY		
CHECKED BY		11-14-86
ENG. APPVL.		11/14/86
MFG APPVL.		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE: .XXX ±, .XX ±, X/X ± 1/64, ∠° ± 1°

WAVETEK

TITLE: SCHEMATIC DIAGRAM FILTER CARD BUTTERWORTH 1Hz-15KHz

SIZE	DRAWING NO.	REV
D	03 004-0840	A

SCALE N/A SHEET 1 OF 1

MAKE FROM 03- 4 -2- 1 F

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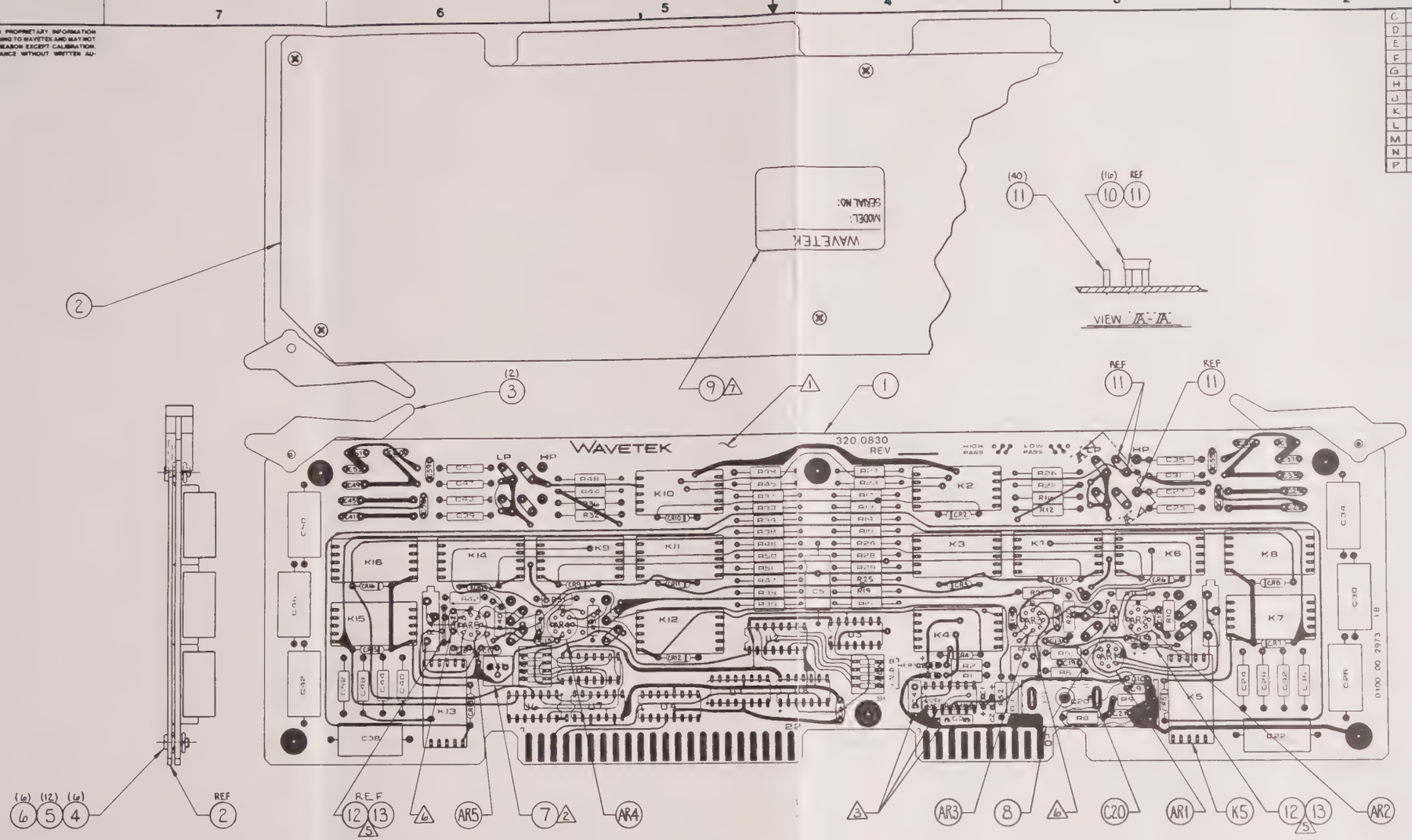
C	157
D	266
E	455
F	705A
G	914
H	936
J	1013
K	1132
L	1154
M	1166
N	22340
P	8210

REV	ECO	BY	DATE	APP
R	9259 REDRAWN	CC	1/11/88	RAB



⚠7 SERIAL NUMBER TAG IS CENTERED ON PLATED SIDE OF SHIELD.

⚠6 SELECT C62, C63, & C64 IN TEST.

⚠5 CONNECT JUMPER TO +SUPPLY FOR OP AMP # 120-1014.

4. LEAD PROTRUSION THRU BOARD TO BE .062 MAX.

⚠3 STANDARD COMPONENTS SHOWN, FOR ALTERNATION USE AS A GROUP VR1 SG 4501 P.N. 120-0157 & C3, C4 .01 μf P.N. 100-3101.

⚠2 RANGE-MULTIPLIER LABEL ITEM 7 IS TRIMMED TO FIT R41, SELF ADHESIVE HOLDS LABEL IN PLACE AFTER R41 IS ADJUSTED. FOR 004-0840 ASSEMBLY, TRIM LABEL TO SHOW X1, X10, X100, & X1K

⚠1 STAMP APPLICABLE PART NO & REV LETTER PER INK SPEC DWG NO. 00-995-0001 APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN: CARLOS CONTRERAS 12/10/87
CHECKED: D. Prussell 1/11/88
PROJ ENGR
RELEASE APPROV: P.R. 1/11/88
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: P.C.B. ASSEMBLY 1 Hz - 1.5 KHz BUTTERWORTH FILTER

SIZE D | FSCM NO 23338 | DWG NO 02-004-0840 | REV R

SCALE 1 1/2 : 1 | MODEL 816 | SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C10 C11 C12 C13 C14 C15 C16 C17 C18 C9	CAP, MOND, .01UF +80 -20% 50V	SR215E103ZAT	AVX	100.3103	10
C6	CAP, MOND, 0.1UF 50V 25U	SR215E104ZAT	AVX	100.4102	1
C54 C55 C56 C57 C58 C59 C60 C61	CAP MICA FX VAL DIP 10PF 5% 200PPM/C 500V	CM05CD100J03	CDE	101.0100	8
C19 C21	CAP FX VAL, DP MICA 100PF 5% 0 TO +70PPM/C 500V	CM05FD101J03	CDE	101.1100	2
C25 C29 C33 C37 C41 C45 C49 C53	CAP MICA FX VAL DIP 910PF 1% 0 TO+70PPM/C 100V	CD15FA911F03	CDE	101.1910	8
C24 C28 C32 C36 C40 C44 C48 C52	CAP, POLYBTY, EPOXY CASE, A/L 0.01UFD 1%, 100V	PSBPC1103F	AMRAD	104.3104	8
C23 C27 C31 C35 C39 C43 C47 C51	CAP, POLYCARB, .1UF 1% 100V	C31B104F	BISHO	104.4100	8
C22 C26 C30 C34 C38 C42 C46 C50	CAP, POLYCARB, 1.0UF 1% 100V	C3113 105F	BISHO	104.5100	8
C3 C4	CAP, PLSTR, .0015UF 10% 100V	225P15291MD3	SPRGE	105.2150	2
C1 C2	CAP, TANT, .10UF 20% 35V	T368A104M035AS	KEMET	109.4100	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0840	1208-00-2693	A
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R6 R9	RES, MFLM 100K 1% 1/10W T2	RN55C1003F	UNCEM	113.1001	2
R12 R16 R22 R26 R32' R36 R44 R48	RES, MFLM 15.9K 1% 1/8W TO	CR125 100PPM	CTLRE	113.1590	8
R8	RES, MFLM 909K 1% 1/8W TO	RN55C9093F	ROHM	113.9090	1
R1 R2	RES, CFLM 10 OHM 5% 1/4W			116.0101	2
R52	RES, CFLM 47 OHM 5% 1/4W			116.0471	1
R41	RES, VAR CMT 20 OHM 3/8SQ FM	72PR20	BECK	118.0200	1
R4	RES, VAR CMT 50 OHM 3/8SQ FM	72PR50	BECK	118.0500	1
R43 R7	RES, VAR CMT 20K 3/4" RECT	3006P1-203	BOURN	118.3200	2
R11	RES, MFLM 57.6 OHM 1% 1/8W TO	RN55C57R6F	UMCEM	119.5760	1
VR1	Q: DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120.0152	1
NONE	ASSY, PC BD PREPPED 816-0840	816-2694	WVTK	1208-00-2694	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0840	1208-00-2693	A
		PAGE 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SCHEMATIC, FILTER CARD "BUTTERWORTH" 1HZ-15KHZ	03.004.0840	WVTK	03.004.0840	1
C20	CAP, VAR MICA, 2-25PF 175V	421	ARCO	108.0230	1
AR1 AR2 AR3 AR4 AR5	U LIN OP-AMP (LF-356)	LF-356MC	TI	120.1014	5
1	ASSY, PRE WAVE LOAD 816-0840	816-2693	WVTK	1208-00-2693	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	FSB-8660	WVTK	1400-01-8660	1
K5	RELAY: REED 4PST 24V 180MW	1503-12-1	MABSH	175.1503	1
8	SHLD: INPUT FILTER CARD 816			304.0906	1
2	PC: SHIELD (816FC)			320.0840	1
10	CONN, PLUG: SHORTING (LOW PROF)	4612872-01-03-10	CTC	352.0202	16
11	SOCKET: JMPR (USE W/352.0202)	4303327-01-0300	CTC	353.0104	40
3	EJECTOR: PC (816)	S-209	SCANB	364.0402	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	OPTION 002 FILTER CARD, BUTTERWORTH.	004 0840	P
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C7 C8	CAP, TANT, 1.0UF 20% 35V	T368A105M035AS	KEMET	109 5100	2
C5	CAP, ELECT, 47UF 20% 63V	47/63-81009	SIEM	109.6470	1
R21	RES, MFLM 340 OHM 1% 1/10W T2	RN55C3400F	UNCEM	110.3401	1
R5	RES, MFLM 453 OHM 1% 1/8W TO	RN55C4530F	UNCEM	110.4530	1
R31	RES, MFLM 887 OHM 1% 1/8W TO	RN55C8870F	UMCEM	110.8870	1
R20 R3 R30 R40	RES, MFLM 1.00K 1% 1/10W T2	RN55C1001F	UMCEM	111 1001	4
R10	RES, MFLM 1.50K 1% 1/10W T2	5063JD1K500F	MEPCO	111 1501	1
R42	RES, MFLM 1.62K 1% 1/8W TO	RN55C1621F	UMCEM	111.1620	1
R15 R19 R25 R29 R35 R39 R47 R51	RES, MFLM 19.9K 1% 1/8W TO	CR125 100PPM	CTLRE	112 1990	8
R14 R18 R24 R28 R34 R38 R46 R50	RES, MFLM 39.8K 1% 1/8W TO	CR125 100PPM	CTLRE	112 3980	8
R13 R17 R23 R27 R33 R37 R45 R49	RES, MFLM 79.6K 1% 1/8W TO	CR125 100PPM	CTLRE	112 7960	8

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0840	1208-00-2693	A
		PAGE 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
U2 U5	U: QUAD 2 IN MPLX (74157)	N74157N-B	SIG	122.0112	2
U7 U8	U: QUAD 2 IN NAND GATE O/C	DM7401N/A+	NSC	122 7401	2
U3 U6	U: HEX INVERT DRIVER O/C	SN7406N-3	TI	122 7406	2
U1 U4	U: 4 BIT LATCH	SN7475N-3	TI	122 7475	2
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	SL LW LK 70PIV 200MW (1N457)			132 0457	16
K1 K10 K11 K12 K13 K14 K15 K16 K2 K3 K4 K6 K7 K8 K9	RELAY, REED 4PST 24V 180MW	1503-12-1	MABSH	175 1503	15
S1 S2	S DIP 4 POLE 2 POS	76SB04	GRAHL	342 4100	2
NONE	SOCKET: I.C. TO-5	8059-207	AUGAT	353 0801	3

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	ASSY, PRE WAVE LOAD 816-0840	1208-00-2693	A
		PAGE 4	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
7	LABEL MULT PROG SWITCH			371 1002	1
4	M SCR ST ZN 4-40 X 3/8 PH			381.4062	6
5	NUT HX ST ZN 4-40X1/4 AF			387 4080	12
6	WASHER INT LK STL IN #4			388 1040	6

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO	REV
	OPTION 002 FILTER CARD, BUTTERWORTH.	004 0840	P
		PAGE 2	

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE
MATERIAL	PROJ ENGR	
	RELEASE APPROV	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030	
	DO NOT SCALE DWG	
	SCALE	

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
PARTS LIST
1 Hz – 15 kHz
BUTTERWORTH FILTER

MODEL NO	DWG NO	REV
816	004.0840	P
CAGE NO 23338	SHEET 1 OF 1	

©WAVETEK GRAPHICS-ACCUPRESS REORDER NO. 427186

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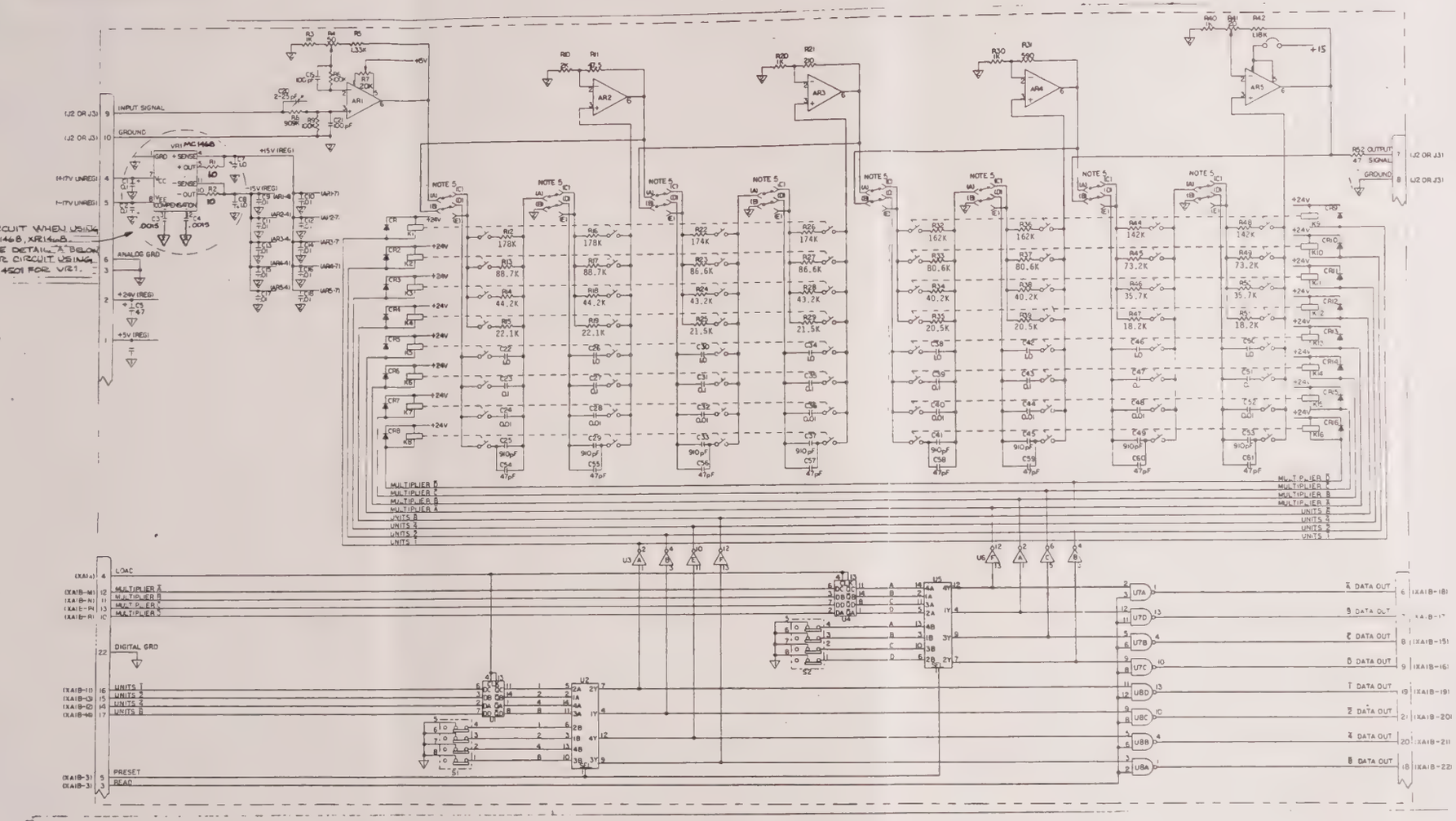
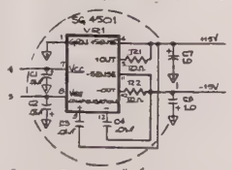
LTR	ECO NO.	CHANGED BY	APPV'D BY	DATE
A	RELEASE 7817	SD11-19-86	mcl	11-21-86



6- STANDARD IC USED FOR VR1 IS A MC1468, XR1468. WHEN USING SG4501 IN THE VR1 POSITION; NOTE THE VALUE CHANGE OF CB & C4 AND CIRCUITRY CHANGE.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS. ALL CAPACITOR VALUES ARE IN MICROFARADS.

2. JUMPERS ARE SHOWN IN 'LOW' PASS CONFIGURATION. PIN A TO PIN C AND PIN B TO PIN D FOR HIGH-PASS CONFIGURATION. CONNECT PIN A TO PIN D AND PIN B TO PIN E. ALL JUMPERS MUST BE CONNECTED THE SAME WAY.

HIGHEST REF DESIG USED:
AR5 C63 CR16 K16 R54 S2 U8 VR1

IC REF DES	
U1	122-7475
U2	0112
U3	7406
U4	7475
U5	0112
U6	7406
U7	7401
U8	122 7401

DRAWN BY:		DATE: 11/18
CHECKED BY:		
ENG APPVL:		
MFG APPVL:		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE: .XXX ±, .XX ±, FRACTIONS ±, ANGLES ±

WAVETEK

TITLE: SCHEMATIC DIAGRAM FILTER CARD BESSEL 1Hz-15KHz

SIZE: D | DRAWING NO.: 03 004-0845 | REV: A

SCALE N/A | SHEET 1 OF 1

MAKE FROM 03-004-0830 1 REV G

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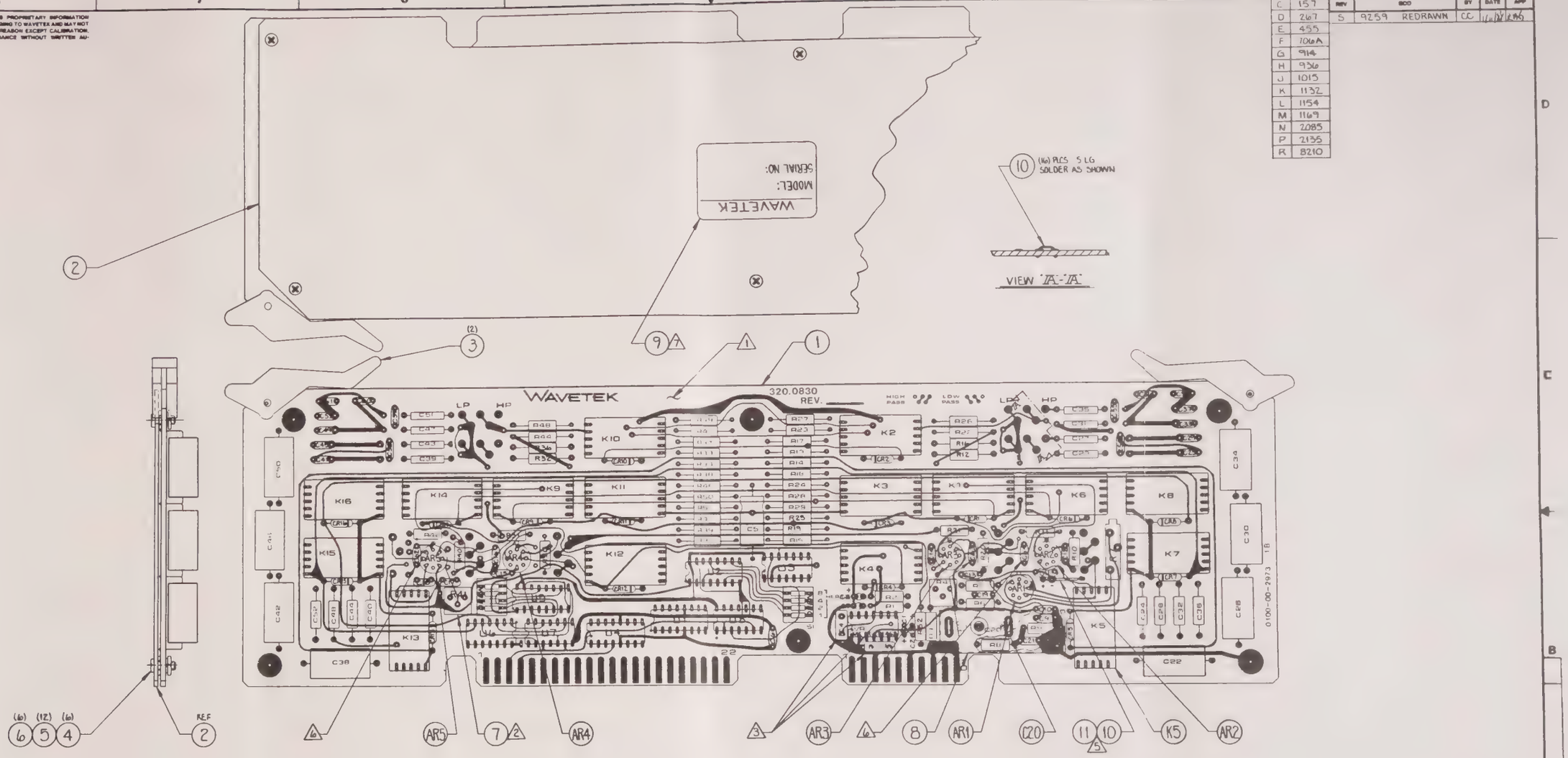
C	157
D	267
E	455
F	706A
G	914
H	936
J	1015
K	1132
L	1154
M	1169
N	2085
P	2135
R	8210

REV	ECO	BY	DATE	APP
S	9259 REDRAWN	CC	12/17/87	



⚠7 SERIAL NUMBER TAG IS CENTERED ON PLATED SIDE OF SHIELD.

⚠6 SELECT C62, C63, & C64 IN TEST.

⚠5 CONNECT JUMPER TO +SUPPLY FOR OP AMP #120-1014.

4. LEAD PROTRUSION THRU BOARD TO BE .062 MAX.

⚠3 STANDARD COMPONENTS SHOWN, FOR ALTERNATION USE AS A GROUP — VR1 SG 4501 P.N. 120-0157 & C3, C4 .01μF P.N. 100-3101

⚠2 RANGE-MULTIPLIER LABEL ITEM 7 IS TRIMMED TO FIT R41. SELF ADHESIVE HOLDS LABEL IN PLACE. AFTER R41 IS ADJUSTED FOR 004-0845 ASSEMBLY, TRIM LABEL TO SHOW X1, X10, X100, & X1K.

⚠1 STAMP APPLICABLE PART NO & REVISION LETTER PER INK SPEC DWG NO 00 995 0001 APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN ARLOS CONTRERAS 12/7/87
CHECKED D Mueppel 1/4/88
PROJ ENGR
RELEASE APPROV K Bh 1/6/88
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX ±.01 .XXX ±.005

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
P.C.B. ASSEMBLY 1Hz-15KHz BESSEL FILTER

SIZE D | FSCM NO 23338 | DWG NO 02-004-0845 | REV S
SCALE 1 1/2:1 | MODEL 816 | SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C10 C11 C12 C13 C14 C15 C16 C17 C18 C9	CAP, MOND, .01UF +80 -20% 50V	SR215E103ZAT	AVX	100.3105	10
C6	CAP, MOND, 0.1UF 50V Z5U	SR215E104ZAT	AVX	100.4102	1
C54 C55 C56 C57 C58 C59 C60 C61	CAP MICA FX VAL DIP 47PF 5% -20+100PPM/C 300V	CM05ED470J03	CDE	101 0470	8
C19 C21	CAP FX VAL, DP MICA 100PF 5% 0 TO +70PPM/C 300V	CM05FD101J03	CDE	101.1100	2
C25 C29 C33 C37 C41 C45 C49 C53	CAP MICA FX VAL DIP 910PF 1% 0 TO+70PPM/C 100V	CD15FA911F03	CDE	101 1910	8
C24 C28 C32 C36 C40 C44 C48 C52	CAP, POLYSTY, EPOXY CASE, A/L 0 01UFD 1%, 100V	PS8PC1103F	AMRAD	104.3104	8
C23 C27 C31 C35 C39 C43 C47 C51	CAP, POLYCARB, 1UF 1% 100V	C31B104F	BISHO	104.4100	8
C22 C26 C30 C34 C38 C42 C46 C50	CAP, POLYCARB, 1.0UF 1% 100V	C3113 105F	BISHO	104.5100	8
C3 C4	CAP, PLSTR, .0015UF 10% 100V	225P15291WD3	SPROE	105.2150	2
C20	CAP, VAR MICA, 2-23PF 175V	421	ARCO	108 0250	1

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-06-0845 | ASSEMBLY NO: 1208-00-2695 | REV: A | PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R25 R29	RES, MFLM 21.5K 1% 1/8W TO	RN55C2152F	NA	112.2150	2
R15 R19	RES, MFLM 221.K 1% 1/8W TO	RN55C2212F	UMCEM	112.2210	2
R46 R50	RES, MFLM 35.7K 1% 1/8W TO	RN55C3572F	UMCEM	112.3570	2
R34 R38	RES, MFLM 40.2K 1% 1/8W TO	NA	NA	112.4020	2
R24 R28	RES, MFLM 43.2K 1% 1/8W TO	NA	NA	112.4320	2
R14 R18	RES, MFLM 44.2K 1% 1/8W TO	RN55C4422F	UMCEM	112.4420	2
R45 R49	RES, MFLM 73.2K 1% 1/8W TO	NA	NA	112.7320	2
R33 R37	RES, MFLM 80.6K 1% 1/8W TO	RN55C8062F	UMCEM	112.8060	2
R23 R27	RES, MFLM 86.6K 1% 1/8W TO	RN55C8662F	UMCEM	112.8660	2
R13 R17	RES, MFLM 88.7K 1% 1/8W TO	RN55C8872F	UMCEM	112.8870	2
R6 R9	RES, MFLM 100K 1% 1/10W T2	RN55C1003F	UMCEM	113.1001	2

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-06-0845 | ASSEMBLY NO.: 1208-00-2695 | REV: A | PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
VR1	U: DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120.0152	1
NONE	ASSY, PC BD PREPPED 816-06-0845	816-06-2696	WVTK	1208-00-2696	1
U2 U5	U: QUAD 2 IN MPLX (74157)	N74157N-B	SIG	122.0112	2
U7 U8	U: QUAD 2 IN NAND GATE O/C	DM7401N/A+	NSC	122.7401	2
U3 U6	U: HEX INVERT DRIVER O/C	SN7406N-3	TI	122 7406	2
U1 U4	U: 4 BIT LATCH	SN7475N-3	TI	122.7475	2
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	SL LW LK 70PIV 200MW (1N457)			132 0457	16
K1 K10 K11 K12 K13 K14 K15 K16 K2 K3 K4 K6 K7 K8 K9	RELAY REED 4PST 24V 180MW	1503-12-1	MABSH	175.1503	15
S1 S2	S: DIP 4 POLE 2 POS	76B804	GRAHL	342.4100	2
XAR1 XAR2 XAR3 XAR4 XAR5	SOCKET: I.C. TO-5	8059-267	AUGAT	353.0801	5

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-06-0845 | ASSEMBLY NO.: 1208-00-2695 | REV: A | PAGE 5

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C1 C2	CAP, TANT, .10UF 20% 35V	T368A104M035A6	KEMET	109.4100	2
C7 C8	CAP, TANT, 1.0UF 20% 35V	T368A105M035AS	KEMET	109 5100	2
C5	CAP, ELECT, 47UF 20% 63V	47/63-81009	SIEM	109 6470	1
R21	RES, MFLM 210 OHM 1% 1/8W TO	RN55C2100F	JMAR	110.2100	1
R31	RES, MFLM 590 OHM 1% 1/8W TO	RN55C5900F	JMAR	110.5900	1
R20 R3 R30 R40	RES, MFLM 1.00K 1% 1/10W T2	RN55C1001F	UMCEM	111.1001	4
R42	RES, MFLM 1.18K 1% 1/10W T2	RN55C1181F	UMCEM	111.1181	1
R5	RES, MFLM 1.33K 1% 1/8W TO	RN55C1131F	KAGAN	111.1330	1
R10	RES, MFLM 2.00K 1% 1/10W T2	RN55C2001F	UMCEM	111.2001	1
R47 R51	RES, MFLM 18.2K 1% 1/8W TO	RN55C1822F	UMCEM	112.1820	2
R39 R39	RES, MFLM 20.5K 1% 1/8W TO	RN55C2052F	UMCEM	112.2050	2

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-06-0845 | ASSEMBLY NO.: 1208-00-2695 | REV: A | PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R44 R48	RES, FX MFLM 143K 1% 1/8W TO	RN55C1433F	NA	113.1430	2
R32 R36	RES, MFLM 162K 1% 1/8W TO	RN55C1623F	NA	113.1620	2
R22 R26	RES, MFLM 174K 1% 1/8W TO	RN55C1743F	UMCEM	113.1740	2
R12 R16	RES, MFLM 178K 1% 1/8W TO	RN55C1783F	UMCEM	113.1780	2
R8	RES, MFLM 909K 1% 1/8W TO	RN55C9093F	ROHM	113.9090	1
R1 R2	RES, CFLM 10 OHM 5% 1/4W			116.0101	2
R52	RES, CFLM 47 OHM 5% 1/4W			116.0471	1
R41	RES, VAR CMT 20 OHM 3/8SQ FM	72PR20	BECK	118.0200	1
R4	RES, VAR CMT 50 OHM 3/8SQ FM	72PR50	BECK	118.0500	1
R7	RES, VAR CMT 20K 3/4" RECT	3006P1-203	BOURN	118.3200	1
R11	RES, MFLM 47.5 OHM 1% 1/8W TO	RN55C47R5F	UTRON	119.4750	1

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-06-0845 | ASSEMBLY NO: 1208-00-2695 | REV: A | PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SCHEMATIC, FILTER CARD "BESSEL" 1HZ-15KHZ	03.004.0845	WVTK	03.004.0845	1
AR1 AR2 AR3 AR4 AR5	U: LIN OP-AMP (LF-356)	LF-356HC	TI	120.1014	5
NONE	ASSY, PRE WAVE LOAD 816-06-0845	816-06-2695	WVTK	1208-00-2695	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	F88-8660	WVTK	1400-01-8660	1
K5	RELAY: REED 4PST 24V 180MW	1503-12-1	MABSH	175.1503	1
NONE	SHLD: IMPUT FILTER CARD 816			304.0906	1
NONE	PC: SHIELD (816FC)			320.0840	1
NONE	CONN, PLUG: SHORTING (LOW PROF)	4612872-01-03-10	CTC	352.0202	16
NONE	SOCKET: JMPR (USE W/352.0202)	4303327-01-0300	CTC	353.0104	40
NONE	EJECTOR: PC (816)	S-209	SCANB	364.0402	2
NONE	LABEL: MULT. PROG SWITCH			371.1002	1
NONE	WIRE: BUSS TINNED 818 AWG	W1818	MEICO	378.0400	11
NONE	WIRE: BUSS TINNED 0220A	9022	MEICO	378.0601	1
NONE	M XCR: ST ZN SL 4-40X3/8 PH			380.4062	6
NONE	NUT: HX ST ZN 4-40X1/4 AF			387.4080	12
NONE	WASHER: INT LK STL ZN #4			388.1040	6

WAVETEK PARTS LIST | TITLE: OPTION 006 FILTER CARD BESSEL FOR MODEL 816-12 | ASSEMBLY NO: 004 0845 | REV: R | PAGE 1

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE
MATERIAL	PROJ ENGR	
	RELEASE APPROV	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030	
	DO NOT SCALE DWG	
	SCALE	

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PARTS LIST 1 Hz – 15 kHz BESSEL FILTER

MODEL NO	DWG NO	REV
816	004 0845	R
CODE IDENT 23338	SHEET 1 OF 1	

BISHOP GRAPHICS/ACCUPRESS RECORD NO. A-2880

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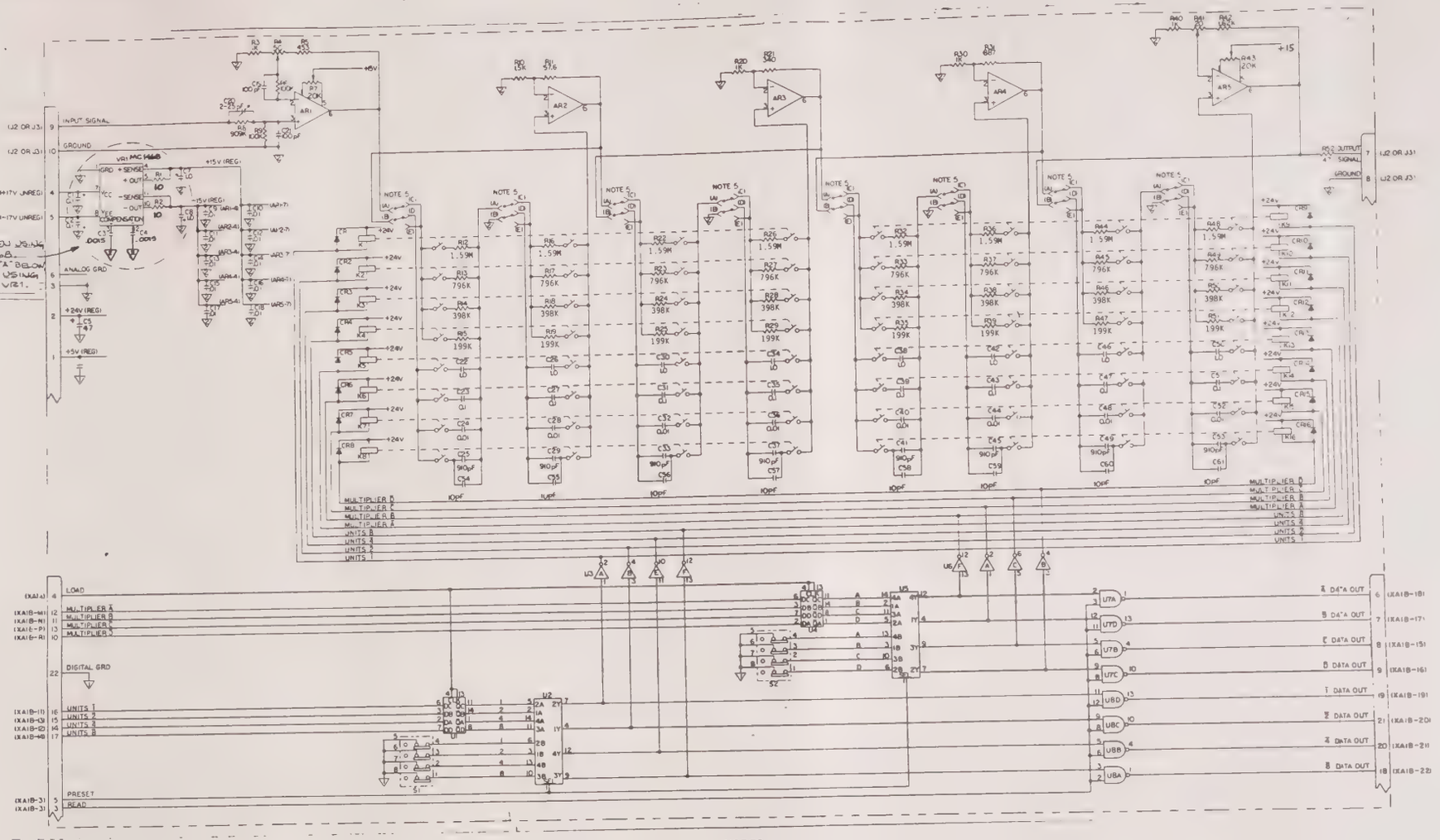
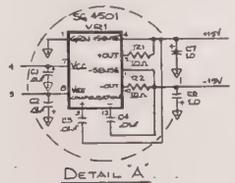
LTR	ECO NO.	CHANGED BY	APPV'D BY	DATE
A	RELEASE 1819	SD 11 18 86	mel	11/7/86



6- STANDARD IC USED FOR VR1 IS A MC1468, XR1468, WHEN USING SG 4501 IN THE VR1 POSITION; NOTE THE VALUE CHANGE OF C3 & C4 AND CIRCUITRY CHANGE.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS. ALL CAPACITOR VALUES ARE IN MICROFARADS.

2. JUMPERS ARE SHOWN IN 'LOW' PASS CONFIGURATION. PIN A TO PIN C AND PIN B TO PIN D. FOR HIGH-PASS CONFIGURATION CONNECT PIN A TO PIN D AND PIN B TO PIN E. ALL JUMPERS MUST BE CONNECTED THE SAME WAY.

HIGHEST REF DESIG USED:
AR5 C63 CR16 K16 R54 S2 U8 VR1

IC REF DES	
U1	122-7475
U2	0112
U3	7406
U4	7475
U5	0112
U6	7406
U7	7401
U8	122 7401

DRAWN BY:	DATE:	11/82
CHECKED BY:		
ENG APPVL:		
MFG APPVL:		

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER PLATING AND TOLERANCES ARE: .XXX ± .XX ± X/X ± 1/64 ∠° ± 1°

WAVETEK

TITLE: SCHEMATIC DIAGRAM FILTER CARD BUTTERWORTH .1Hz-1.5KHz

SIZE: D | DRAWING NO.: 03 004-0850 | REV: A

SCALE: N/A | SHEET 1 OF 1

MAKE FROM 03-004-0850 REV A

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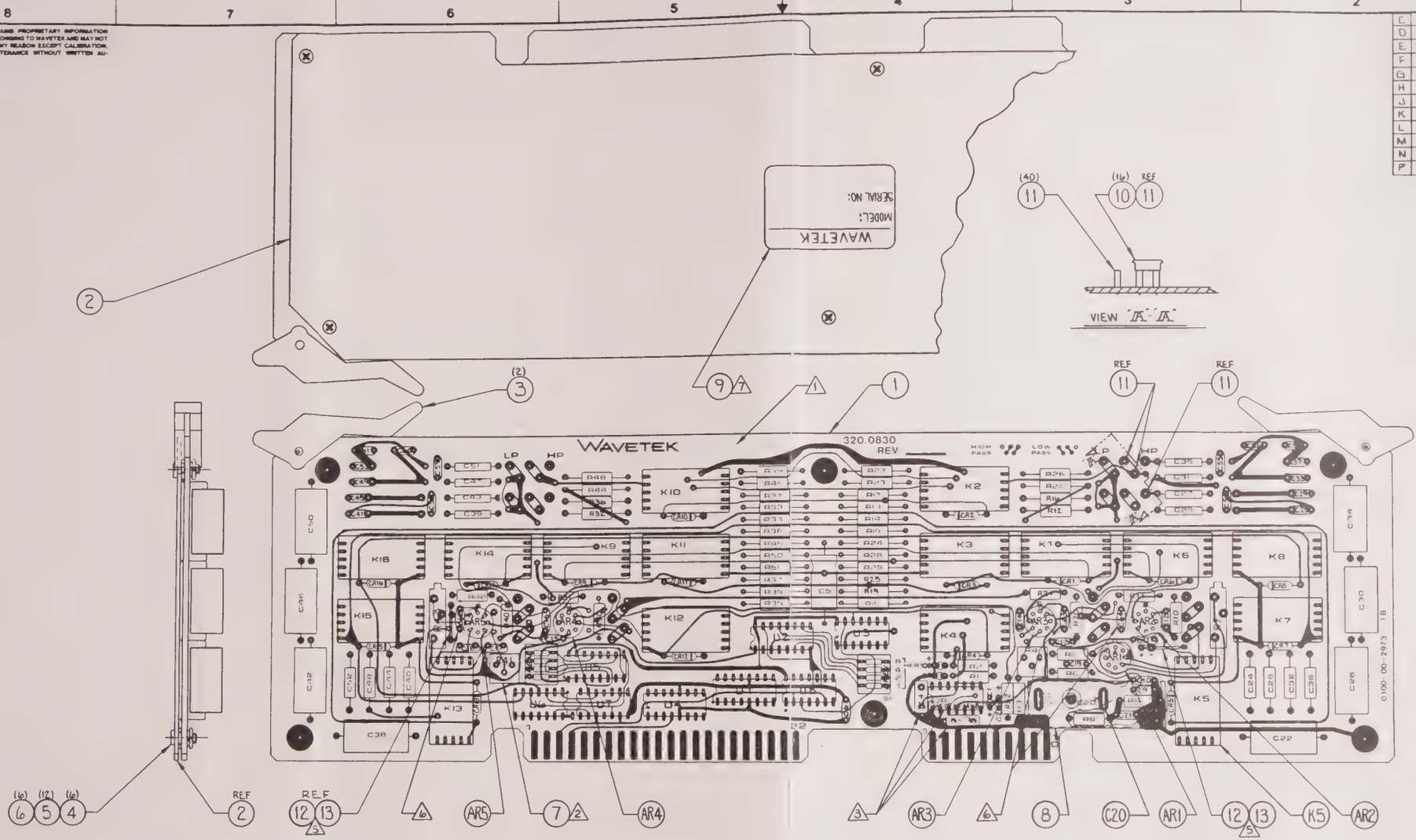
REV	ECO	BY	DATE	APP
R	9259 REDRAWN	CC	1/11/88	LHG

C	157
D	268
E	455
F	707A
G	914
H	936
J	1015
K	1132
L	1154
M	1169
N	2236
P	8210



⚠7 SERIAL NUMBER TAG IS CENTERED ON PLATED SIDE OF SHIELD.

⚠6 SELECT C62, C63, & C64 IN TEST.

⚠5 CONNECT JUMPER TO +SUPPLY FOR OP AMP #120-1014.

4. LEAD PROTRUSION THRU BOARD TO BE .062 MAX.

⚠3 STANDARD COMPONENTS SHOWN FOR ALTERNATION USE AS A GROUP VR1 SG 4501 P.N.120 0157 & C3, C4 .01μF P.N. 100-3101.

⚠2 RANGE - MULTIPLIER LABEL ITEM 7 IS TRIMMED TO FIT R41. SELF ADHESIVE HOLDS LABEL IN PLACE AFTER R41 IS ADJUSTED. FOR 004-0850 ASSEMBLY, TRIM LABEL TO SHOW X.1 X1 X10 & X100.

⚠1 STAMP APPLICABLE PART NO & REV LETTER PER INK SPEC DWG NO 00-995-0001 APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN ARLO S CONTRERAS 12/15/87
CHECKED 1/11/88
PROJ ENGR.
RELEASE APPROV. P.V.G. 1/11/88

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES
.XX ± .01
.XXX ± .005

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
P.C.B. ASSEMBLY, 0.1Hz-1.5KHz BUTTERWORTH FILTER

SIZE	FSCM NO	DWG NO	REV
D	23338	02-004-0850	R

SCALE 1½:1 MODEL 816 SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C10 C11 C12 C13 C14 C15 C16 C17 C18 C9	CAP, MOND, .01UF +80 -20% 50V	SR215E103ZAT	AVX	100 3105	10
C6	CAP, MOND, 0 1UF 50V Z5U	SR215E104ZAT	AVX	100 4102	1
C54 C55 C56 C57 C58 C59 C60 C61	CAP MICA FX VAL DIP 10PF 5% 200PPM/C 500V	CM05CD100J03	CDE	101 0100	8
C19 C21	CAP FX VAL, DP MICA 100PF 5% 0 TO +70PPM/C 300V	CM05FD101J03	CDE	101 1100	2
C25 C29 C33 C37 C41 C45 C49 C53	CAP MICA FX VAL DIP 910PF 1% 0 TO+70PPM/C 100V	CD15FA911F03	CDE	101 1910	8
C24 C28 C32 C36 C40 C44 C48 C52	CAP, POLYSTY, EPOXY CASE, A/L 0.01UFD 1%, 100V	PSBPC1103F	AMRAD	104 3104	8
C23 C27 C31 C35 C39 C43 C47 C51	CAP, POLYCARB, .1UF 1% 100V	C31B104F	BISHO	104 4100	8
C22 C26 C30 C34 C38 C42 C46 C50	CAP, POLYCARB, 1 0UF 1% 100V	C3113 105F	BISHO	104 5100	8
C3 C4	CAP, PLSTR, .0015UF 10% 100V	225P15291WD3	SPRGE	105 2150	2
C1 C2	CAP, TANT, .10UF 20% 35V	T368A104M035A9	KEMET	109 4100	2

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-0850 | ASSEMBLY NO. 1208-00-2689 | REV

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
R13 R17 R23 R27 R33 R37 R45 R49	RES, VAL CERMET 796K 1% 100PPM/C RN60 SIZE	HA60-796K-1%-100PPM	HYMEG	113 7960	8
R8	RES, MFLM 909K 1% 1/8W TO	RN55C9093F	ROHM	113 9090	1
R12 R16 R22 R26 R32 R36 R44 [illegible]	RES, MFLM 1 59M 1% 1/8W TO	HA60 100PP	HYMEG	114 1590	8
R1 R2	RES, CFLM 10 OHM 5% 1/4W			116 0101	2
[illegible]	RES, CFLM 47 OHM 5% 1/4W			116 0471	1
R41	RES, VAR CMT 20 OHM 3/8SQ FM	72PR20	BECK	118 0200	1
[illegible]	RES, VAR CMT 50 OHM 3/8SQ FM	72PR50	BECK	118 0500	1
R43 R7	RES, VAR CMT 20K 3/4" RECT	3006P1-203	BOURN	118 3200	2
R11	RES, MFLM 57.6 OHM 1% 1/8W TO	RN55C57R6F	UMCEM	119 5760	1
VR1	G. DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120 0152	1
NONE	ASSY, PC BD PREPPED 816-0850	816-2690	WVTK	1208-00-2690	1

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-0850 | ASSEMBLY NO 1208-00-2689 | REV

PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	SCHEMATIC, FILTER CARD "BUTTERWORTH"	03 004 0850	WVTK	03 004 0850	1
C20	CAP, VAR MICA, 2-25PF 175V	421	ARCO	108 0250	1
AR1 AR2 AR3 AR4 AR5	U LIN OP-AMP (LF-356)	LF-356HC	TI	120 1014	5
NONE	ASSY, PRE WAVE LOAD 816-0850	816-2689	WVTK	1208-00-2689	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	FSS-8660	WVTK	1400-01-8660	1
K5	RELAY REED 4PST 24V 180MW	1503-12-1	WABSH	175 1503	1
NONE	SHLD INPUT FILTER CARD 816			304 0906	1
NONE	PC SHIELD (816FC)			320 0840	1
NONE	CONN, PLUG SHORTING (LOW PROF)	4612872-01-03-10	CTC	352 0202	16
NONE	SOCKET JMPR (USE W/352 0202)	4303327-01-0300	CTC	353 0104	40
NONE	EJECTOR PC (816)	8-209	SCANB	364 0402	2
NONE	LABEL MULT PROG			371 1002	1

WAVETEK PARTS LIST | TITLE: OPTION 003 FILTER CARD BUTTERWORTH. | ASSEMBLY NO 004 0850 | REV P

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
C7 C8	CAP, TANT, 1.0UF 20% 35V	T368A105M035AS	KEMET	109 5100	2
C5	CAP, ELECT, 47UF 20% 63V	47/63-81009	BIEM	109 6470	1
R21	RES, MFLM 340 OHM 1% 1/10W T2	RN55C3400F	UMCEM	110 3401	1
[illegible]	RES, MFLM 453 OHM 1% 1/8W TO	RN55C4530F	UMCEM	110 4530	1
R31	RES, MFLM 887 OHM 1% 1/8W TO	RN55C8870F	UMCEM	110 8870	1
R20 R3 R30 R40	RES, MFLM 1.00K 1% 1/10W T2	RN55C1001F	UMCEM	111 1001	4
R10	RES, MFLM 1.50K 1% 1/10W T2	5063JD1K500F	MEPCO	111 1501	1
R42	RES, MFLM 1 62K 1% 1/8W TO	RN55C1621F	UMCEM	111 1620	1
R6 R9	RES, MFLM 100K 1% 1/10W T2	RN55C1003F	UMCEM	113 1001	2
R15 R19 R25 R29 R35 R39 R47 R51	RES, MFLM 199K 1% 1/8W TO	CR125 100PPM	CTLRE	113 1990	8
R14 R18 R24 R28 R34 R38 R46 R50	RES, MFLM 398K 1% 1/8W TO	CR125 100PPM	CTLRE	113 3980	8

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-0850 | ASSEMBLY NO 1208-00-2689 | REV

PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
U2 U5	U QUAD 2 IN MPLX (74157)	N74157N-B	SIG	122 0112	2
U7 U8	U QUAD 2 IN NAND GATE O/C	DM7401N/A+	NSC	122 7401	2
U3 U6	U HEX INVERT DRIVER O/C	SN7406N-G	TI	122 7406	2
U1 U7	U 4 BIT LATCH	SN7475N-3	TI	122 7475	2
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	SL LM LK 70PIV 200MW (1N457)			132 0457	16
K1 K10 K11 K12 K13 K14 K15 K16 K2 K3 K4 K6 K7 K8 K9	RELAY REED 4PST 24V 180MW	1503-12-1	WABSH	175 1503	15
S1 S2	S. DIP 4 POLE 2 POS	76BB04	GRAHL	342 4100	2
NONE	SOCKET: I.C. TO-5	8059-207	AUGAT	353 0801	5

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-0850 | ASSEMBLY NO 1208-00-2689 | REV

PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
	SWITCH				
NONE	M XCR ST ZN SL 4-40X3/8 PH			380 4062	6
NONE	NUT HX ST ZN 4-40X1/4 AF			387 4080	12
NONE	WASHER INT LK STL ZN [illegible]			388 1040	6

WAVETEK PARTS LIST | TITLE: OPTION 003 FILTER CARD BUTTERWORTH. | ASSEMBLY NO 004 0850 | REV P

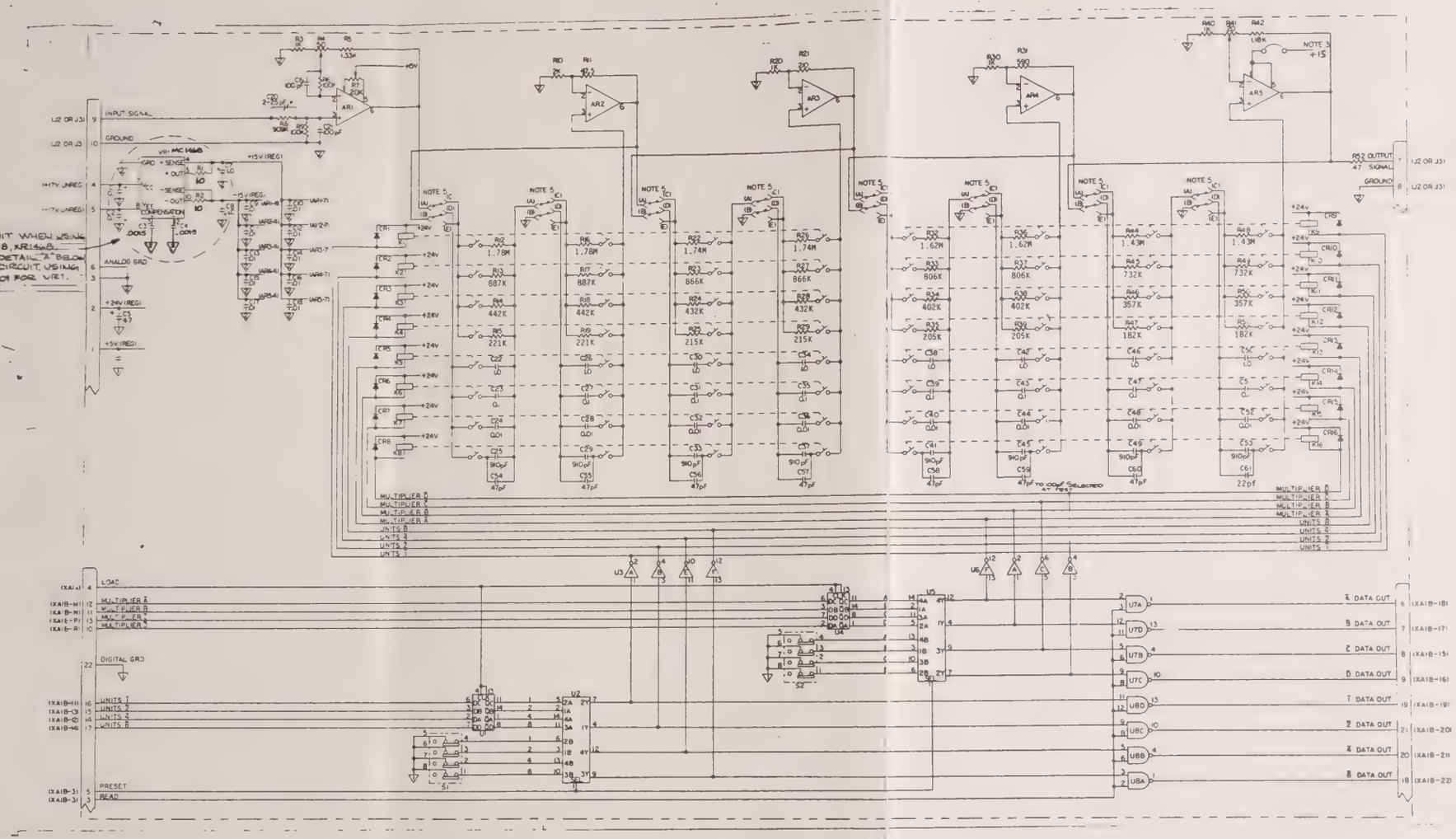
PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

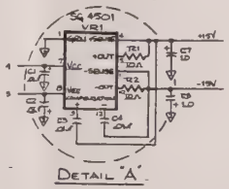
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: PARTS LIST 0.1 Hz – 1.5 kHz BUTTERWORTH FILTER
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG		MO 816 / DWG A 004 0850 / REV P
	SCALE		CODE IDENT 23338 / SHEET 1 OF 1

©SHOP GRAPHICS/ACCUPRESS REORDER NO A-3884

LTR	ECO NO	CHANGED BY	APPV'D BY	DATE
A	RELEASE SD 11-12-84			



6- STANDARD IC USED FOR VR1 IS A MC1468, XR1468. WHEN USING SG4501 IN THE VR1 POSITION, NOTE THE VALUE CHANGE OF C3 & C4 AND CIRCUITRY CHANGE.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS. ALL CAPACITOR VALUES ARE IN MICROFARADS.

2. JUMPERS ARE SHOWN IN 'LOW' PASS CONFIGURATION. PIN A TO PIN C AND PIN B TO PIN D FOR HIGH-PASS CONFIGURATION. CONNECT PIN A TO PIN D AND PIN B TO PIN E. ALL JUMPERS MUST BE CONNECTED THE SAME WAY.

HIGHEST REF DESIG USED:
AR5 C63 CR16 K16 R54 S2 U8 VR1

IC REF DES	
U1	122-7475
U2	0112
U3	7406
U4	7475
U5	0112
U6	7406
U7	7401
U8	122 7401

DRAWN BY:
CHECKED BY:
ENG APPR.:
MFG. APPR.:
DATE: 11-14-84

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES AFTER FINISHING AND TOLERANCES ARE:
.XXX ±
.XX ±
FRACTIONS ± 1/64
ANGLES ± 1°

ROCKLAND
Rockland Systems Corporation

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TITLE: SCHEMATIC DIAGRAM FILTER CARD BESSEL .1Hz - 1.5KHz

SIZE D | DRAWING NO. 03 004-0855 | REV A

SCALE | SHEET 1 OF 1

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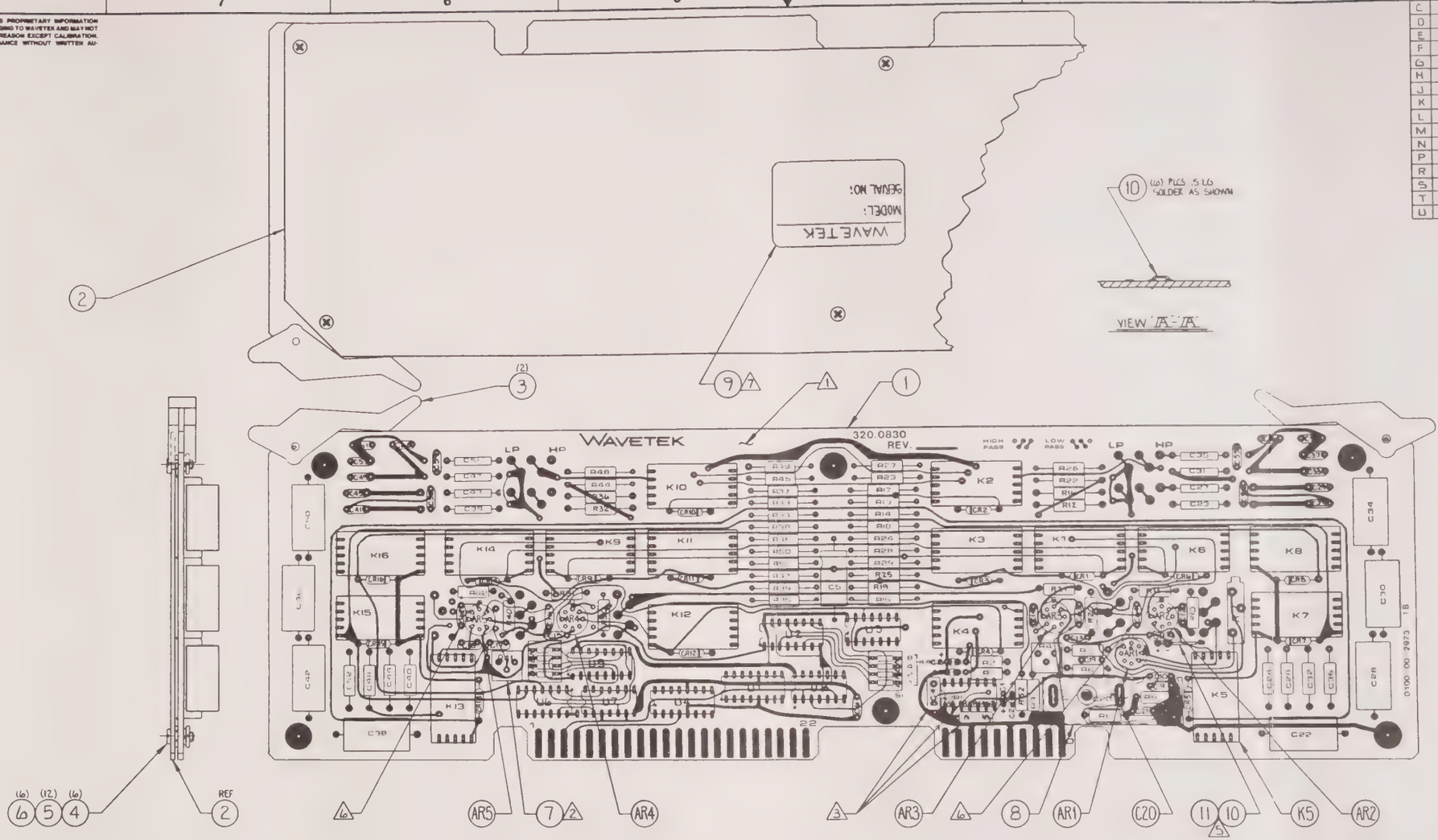
C	157
D	269
E	455
F	708A
G	914
H	936
J	1015
K	1132
L	1154
M	1169
N	1770
P	1790
R	2236
S	7776
T	B210
U	B436

REV	ECO	BY	DATE	APP
V	9259 REDRAWN	CC	1/18/88	RMH



7. SERIAL NUMBER TAG IS CENTERED ON PLATED SIDE OF SHIELD.

6. SELECT C62, C63, & C64 IN TEST.

5. CONNECT JUMPER TO + SUPPLY FOR OP AMP #120 1014.

4. LEAD PROTRUSION THRU BOARD TO BE .062 MAX.

3. STANDARD COMPONENTS SHOWN FOR ALTERNATION. USE AS A GROUP
VR1 5G 4501 P.N. 120-0157 & C3, C4 .01 µf P.N. 100-3101.

2. RANGE-MULTIPLIER LABEL ITEM 7 IS TRIMMED TO FIT R41. SELF ADHESIVE HOLDS LABEL IN PLACE. AFTER R41 IS ADJUSTED. FOR 004-0855 ASSEMBLY, TRIM LABEL TO SHOW X.1, X1, X10, & X100.

1. STAMP APPLICABLE PART NO & REVISION LETTER PER INK SPEC DWG NO 00 995 0001 APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DO NOT SCALE DRAWING

DRAWN: CARLOS CONTRERAS 12-22-87
CHECKED: D. Bullock 1/4/88
PROJ ENGR:
RELEASE APPROV: K.P.G. 1/11/88

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: P.C.B. ASSEMBLY, 0.1 Hz-1.5 KHz BESSEL FILTER

SIZE	PROM NO	DWG NO	REV
D	23338	02 004 0855	V

SCALE 1/2:1 MODEL 816 SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C10 C11 C12 C13 C14 C15 C16 C17 C18 C9	CAP, MOND, .01UF +80 -20% 50V	SR215E103ZAT	AVX	100.3103	10
C6	CAP, MOND, 0.1UF 50V Z5U	SR215E104ZAT	AVX	100.4102	1
C61	CAP MICA FX VAL DIP 22PF 5% -20+100PPM/C 500V	CM05ED220J03	CDE	101 0220	1
C54 C55 C56 C57 C58 C59	CAP MICA FX VAL DIP 47PF 5% -20+100PPM/C 500V	CM05ED470J03	CDE	101.0470	6
C19 C21 C60	CAP FX VAL, DP MICA 100PF 5% 0 TO +70PPM/C 500V	CM05FD101J03	CDE	101 1100	3
C25 C29 C33 C37 C41 C45 C49 C53	CAP MICA FX VAL DIP 910PF 1% 0 TO+70PPM/C 100V	CD15FA911F03	CDE	101.1910	8
C24 C28 C32 C36 C40 C44 C48 C52	CAP, POLYSTY, EPOXY CASE, A/L 0.01UFD 1%, 100V	PSBPC1103F	AMRAD	104 3104	8
C23 C27 C31 C35 C39 C43 C47	CAP, POLYCARB, 0.1UF, -.5+0%, 50V	MPABPC1104E	AMRAD	104 4103	7
C51	CAP, POLYCARB, .1UF +.5 -0% 50V.	MPABPC0104E	AMRAD	104.4109	1
C22 C26 C30 C34 C38 C42 C46	CAP, POLYCARB, 1 0UF-.5	MPABPC0105E	AMRAD	104 5103	7

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-07-0855 | ASSEMBLY NO: 1208-00-2697 | REV | PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	+0%, 50V				
C50	CAP, POLYCARB, 1.0UF +.5-0% 50V	MPABPC0105E	AMRAD	104.5109	1
C3 C4	CAP, PLSTR, .0015UF 10% 100V	225P15291WD3	SPRGE	105.2150	2
C1 C2	CAP, TANT, .10UF 20% 35V	T368A104M035A6	KEMET	109.4100	2
C7 C8	CAP, TANT, 1.0UF 20% 35V	T368A105M035AS	KEMET	109.5100	2
C5	CAP, ELECT, 47UF 20% 63V	47/63-81009	SIEM	109.6470	1
R21	RES, MFLM 210 OHM 1% 1/8W TO	RN55C2100F	JMAR	110.2100	1
R31	RES, MFLM 590 OHM 1% 1/8W TO	RN55C5900F	JMAR	110.5900	1
R20 R3 R30 R40	RES, MFLM 1.00K 1% 1/10W T2	RN55C1001F	UMCEM	111.1001	4
R42	RES, MFLM 1.18K 1% 1/10W T2	RN55C1181F	UMCEM	111.1181	1
R5	RES, MFLM 1.33K 1% 1/8W TO	RN55C1131F	KAGAN	111.1330	1
R10	RES, MFLM 2.00K 1%	RN55C2001F	UMCEM	111.2001	1

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-07-0855 | ASSEMBLY NO: 1208-00-2697 | REV | PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
	1/10W T2				
R6 R9	RES, MFLM 100K 1% 1/10W T2	RN55C1003F	UMCEM	113.1001	2
R47 R51	RES, MFLM 182K 1% 1/8W TO	RN55C1823F	JACO	113 1820	2
R35 R39	RES, MFLM 205K 1% 1/10W T2	RN55C2053F	UMCEM	113 2051	2
R25 R29	RES, MFLM 215K 1% 1/8W TO	RN55C2153F	JACO	113 2150	2
R15 R19	RES, MFLM 221K 1% 1/8W TO	RN55C2213F	JACO	113 2210	2
R46 R50	RES, MFLM 357K 1% 1/8W TO	RN55C3573F	CTLRE	113.3570	2
R34 R38	RES, MFLM 402K 1% 1/8W TO	RN55C4023F	JACO	113.4020	2
R24 R28	RES, MFLM 432K 1% 1/8W TO	RN55C4323F	JACO	113.4320	2
R14 R18	RES, MFLM 442K 1% 1/8W TO	RN55C4423F	JACO	113.4420	2
R45 R49	RES, MFLM 732K 1% 1/8W TO	RN55C7323F	JACO	113.7320	2
R33 R37	RES, MFLM 806K 1% 1/8W TO	RN55C8063F	JMAR	113.8060	2
R23 R27	RES, MFLM 866K 1% 1/8W TO	RN55C8663F	UMCEM	113.8660	2
R13 R17	RES, MFLM 887K 1% 1/8W TO	RN55C8873F	UMCEM	113.8870	2
R8	RES, MFLM 909K 1% 1/8W TO	RN55C9093F	ROHM	113.9090	1
R44 R48	RES, MFLM 1.43M 1% 1/8W TO	RN1/4(T1)1.43M,1%	STKPL	114.1430	2
R32 R36	RES, MFLM 1.62M 1% 1/8W TO	RN1/4(T1)1.62MEQ,+-1%	STKPL	114 1620	2
R22 R26	RES, MFLM 1.74M 1% 1/8W TO	MA55	HYMEQ	114.1740	2
R12 R16	RES, MFLM 1.78M 1% 1/8W TO	MA55 100PPM	HYMEQ	114.1780	2
R1 R2	RES, CFLM 10 OHM 5% 1/4W			116.0101	2
R52	RES, CFLM 47 OHM 5% 1/4W			116.0471	1
R41	RES, VAR CMT 20 OHM 3/8SQ FM	72PR20	BECK	118.0200	1
R4	RES, VAR CMT 50 OHM	72PR50	BECK	118.0500	1

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-07-0855 | ASSEMBLY NO: 1208-00-2697 | REV | PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
	3/8SQ FM				
R7	RES, VAR CMT 20K 3/4" RECT	3006P1-203	BOURN	118 3200	1
R11	RES, MFLM 47.5 OHM 1% 1/8W TO	RN55C47R5F	UTRON	119 4750	1
VR1	G: DL VOLT REG 15V 100MA DIP	MC1468L	MOT	120 0152	1
NONE	ASSY, PC BD PREPPED 816-07-0855	816-07-2698	WVTK	1208-00-2698	1
U2 U5	U: QUAD 2 IN MPLX (74157)	N74157N-8	SIG	122 0112	2
U7 U8	U: QUAD 2 IN NAND GATE O/C	DM7401N/A+	NSC	122 7401	2
U3 U6	U: HEX INVERT DRIVER O/C	SN7406N-3	TI	122 7406	2
U1 U4	U: 4 BIT LATCH	SN7475N-3	TI	122 7475	2
CR1 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	SL LM LK 70PIV 200MW (1N457)			132 0457	16
K1 K10 K11 K12 K13 K14 K15 K16 K2 K3 K4 K6 K7 K8 K9	RELAY, REED 4PST 24V 180MW	1503-12-1	MAGSH	175 1503	15
S1 S2 15	S: DIP 4 POLE 2 P C SOCKET I.C. TO *	76SB04 8059-207	GRAHL AUGAT	342 4100 353 0801	2 5

WAVETEK PARTS LIST | TITLE: ASSY, PRE WAVE LOAD 816-07-0855 | ASSEMBLY NO: 1208-00-2697 | REV | PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO	QTY/PT
NONE	TEST PROCEDURE, SYS 816, OPTION 07 FILTER PCB	0003-00-0515	WVTK	0003-00-0515	1
NONE	SCHEMATIC, FILTER CARD "BESSEL" 1HZ-1.5KHZ	03.004 0855	WVTK	03 004 0855	1
C20	CAP, VAR MICA, 2-29PF 175V	421	ARCO	109 0250	1
AR1 AR2 AR3 AR4 AR5	U: LIN OP-AMP (LF-356)	LF-356HC	TI	120 1014	5
NONE	ASSY, PRE WAVE LOAD 816-07-0855	816-07-2697	WVTK	1208-00-2697	1
NONE	LABEL, SERIAL NUMBER/FILTERS & SYNTHESIZERS	FSB-8660	WVTK	1400-01-8660	1
K5	RELAY: REED 4PST 24V 180MW	1503-12-1	MAGSH	175 1503	1
8	SHLD INPUT FILTER CARD 816			364 0906	1
2	PC. SHIELD (816FC)			320.0840	1
3	EJECTOR: PC (816)	8-209	MCANB	364.0402	2
7	LABEL MULT PROG SWITCH			371.1002	1
9	WIRE BUSS HD DWN TND #22 AWG	M2222	MEICO	378.0600	12
4	M XCR ST ZN SL 4-40X3/8 PH			380.4062	6
6	NUT: HX ST ZN 4-40X1/4 AF			387.4090	12
5	WASHER INT LK STL ZN #4			388 1040	6

WAVETEK PARTS LIST | TITLE: OPTION 007 FILTER CARD BESSEL FOR MODEL 816-13 | ASSEMBLY NO: 004 0855 | REV: U | PAGE 1

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DRAWN | DATE | PROJENGR | RELEASE APPROV | TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030 | DO NOT SCALE DWG | SCALE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PARTS LIST 0.1 Hz – 1.5 kHz BESSEL FILTER

MODEL NO: 816 | DWG NO: 004.0855 | REV: U | FSCM NO: 03338 | SHEET 1 OF 1

BISHOP GRAPHICS/ACCUPRESS RECORDED NO. A-2884

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	CLAMP: CABLE NYLON 1/4"	773	SMITH	362.1603	4
NONE	CLAMP: CABLE NYLON 1/2"	8961	SMITH	362.1604	4
NONE	CLAMP: CABLE NYLON 1"	8952	SMITH	362.1605	4
NONE	M SCR: ST ZN 6L 8-32X3/8 PH			380.8062	4
NONE	WASHER: FLAT STL #8 .172ID 3/8OD .032THK			388.0080	4
NONE	SPR: THD 3/8HX 8-32X1	1452E	KEYST	389.2003	4

WAVETEK PARTS LIST	TITLE: STRAIN RELIEF KIT 816	ASSEMBLY NO. 002.0899	REV A
		PAGE 1	

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST STRAIN RELIEF KIT
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ±1 XX ± .030		
	DO NOT SCALE DWG	MODEL NO. 816	PART NO. 002.0899 REV A
	SCALE	CODE IDENT 23338	SHEET 1 OF 1

NOTE UNLESS OTHERWISE SPECIFIED

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